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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **4435**

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Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **4443**

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Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **4459**

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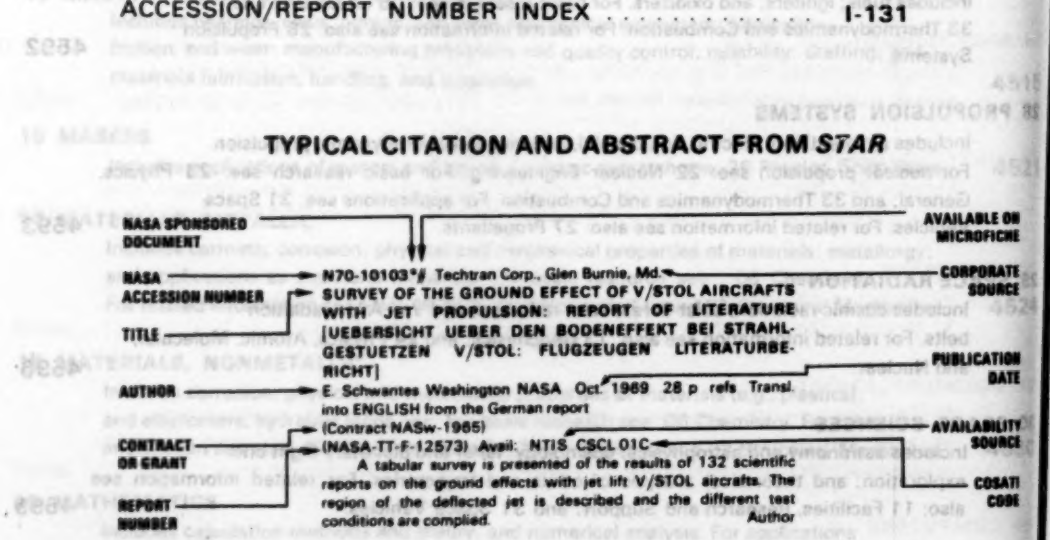
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A tabular survey is presented of the results of 132 scientific reports on the ground effects with jet lift V/STOL aircrafts. The region of the deflected jet is described and the different test conditions are complied.
Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N70-42020*# Scientific Translation Service, Santa Barbara, Calif.
AERODYNAMICS: AN ASYMPTOTIC STUDY OF PERFECT FLUID FLOWS AROUND WEAKLY LIFTING THREE-DIMENSIONAL BODIES, IN THE SONIC REGIME [AERODYNAMIQUE: ETUDE ASYMPTOTIQUE D'ECOULEMENTS DE FLUIDE PARFAIT AUTOUR DE CORPS TRIDIMENSIONNELS FAIBLEMENT PORTANTS, EN REGIME SONIQUE]
G. Tournemine et al. Washington NASA Oct. 1970 8 p refs Transl. into ENGLISH from Compt. Rend., Ser. A (Paris), v. 270, 12 Jan. 1970 p 162–165
(Contract NASw-2035)
(NASA-TT-F-13319) Avail: NTIS CSCL 20D

A method is proposed for sonic flows at a large distance from a weakly lifting three-dimensional body, behind the shock wave. The dominant term is a pseudo-rotational flow defined in a previous report. The existence of a lifting boundary layer is proved at infinity downstream, which thus places the problem within the realm of the theory of singular perturbations. An interior expansion is introduced, and because of the definition of different methods of passing to the limit, the matching principle allows determination of the exponents as well as the behavior of the functions. An expression for the lift is given. Author

N70-42087*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF AIR-CUSHION MODELS AT VERY LOW GROUND CLEARANCES AND AT FREE-STREAM DYNAMIC PRESSURES EXCEEDING CUSHION PRESSURE
Kalman J. Grunwald and William G. Johnson, Jr. Washington, D.C. Oct. 1970 128 p refs
(NASA-TN-D-6011; L-7369) Avail: NTIS CSCL 20D

Air cushion models employing peripheral jet and plenum cushions of circular, rectangular, and side-by-side planforms were tested in hovering and at forward speed in the 17-foot (5.18-meter) test section of a 300-MPH 7- by 10-foot tunnel. The principal purpose of these tests was to study the characteristics of air cushions when free stream dynamic pressure exceeded air-cushion pressure. Also examined were the hovering performance and the effects of moving ground belt, crosswind, height, and angle of attack. For the configurations tested, there was no significant loss in cushion performance when free stream dynamic pressure exceeded cushion pressure. Author

N70-42092*# National Aeronautics and Space Administration. Manned Spacecraft Center, Langley Station, Va.
FREE-FLIGHT MEASUREMENTS OF DYNAMIC STABILITY DERIVATIVES OF A BLUNTED 120 DEG CONE IN HELIUM AT MACH NUMBER 15.4
Frederick W. Gibson and James E. Carter Washington Oct. 1970 23 p refs
(NASA-TM-X-2071; L-6883) Avail: NTIS CSCL 20D

The dynamic stability derivatives of a blunted 120 deg cone with different center-of-gravity locations for various amplitudes of oscillation were determined at a Mach number of 15.4 in helium. A free-flight method was utilized and the data thus acquired are compared with unmodified Newtonian theory predictions and experimental results obtained in air. Author

N70-42138*# Translation Consultants, Ltd., Arlington, Va.
EXPLICIT SCHEMES OF THE LOCATION METHOD IN THE PROBLEM OF SUPERSONIC FLOWS AROUND A BLUNT BODY [O YAVNYKH SKHEMAKH METODA USTANOVLENIYA V ZADACHE SUERKHZVUKOVOGO OBTEKANIYA ZATUPLENNOGO TELA]
A. P. Kosykh et al. Washington NASA Oct. 1970 11 p refs Transl. into ENGLISH from Z. Vychislitelnoi Mat. i Mat. Fiz. (Moscow), v. 10, no. 2, 1970 p 514–520
(Contract NASw-2038)
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Various schemes of the location method in computing supersonic flows around a blunt body are discussed and compared. Indirect methods indicated low accuracies in the computations, and a comparison of computations using the direct method for three schemes of the integral relation method, the line method, and the location method indicated good agreement of results obtained. Author

N70-42151# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
BIBLIOGRAPHY: NUMBERED REPORTS AND THESES, AERONAUTICAL ENGINEERING AND AEROSPACE AND MECHANICAL SCIENCES, PRINCETON UNIVERSITY, 1947–1970
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Reports and theses are listed by identification number, author, title, price and availability. TAB

N70-42208*# Translation Consultants, Ltd., Arlington, Va.
INVESTIGATION OF TURBULENCE NOISE [UNTERSUCHUNGEN UEBER DEN TURBULENZLAERM]
O. Bschorr (Ph.D. Thesis—Tech. Hochschule Munich, 1968) Washington NASA Oct. 1970 59 p refs Trans. into ENGLISH of German Ph.D. thesis p 1–56
(Contract NASw-2038)
(NASA-TT-F-13331) Avail: NTIS CSCL 20D

The intensity and spectrum of noise generated by turbulence is investigated. The concepts and problem-solving techniques of statistical thermodynamics are transferred to a field of turbulence on the basis of the assumption that a homogeneous, isotropic and (quasi) stationary turbulence field is subjected to a canonical distribution. The study is limited to the acoustic component of turbulence. The results for a linearized case are discussed. Author

N70-42331*# Techtran Corp., Glen Burnie, Md.
TRANSONIC FLOW PAST SLENDER BODIES [TRANSZVUKOVOVE OBTEKANIYE TONKIKH TEL]
Yu. B. Lifshits Washington NASA Oct. 1970 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), Jul.–Aug. 1968 p 129–133
(Contract NASw-2037)
(NASA-TT-F-13251) Avail: NTIS CSCL 20D

The flow pattern at three dimensional slender bodies is determined by a perturbation method, termed the method of splicing asymptotic expansions, in which the maximum relative thickness is taken as a small parameter. It is shown that it is possible to overcome the difficulties arising from the nonlinearity of the equation for the external transonic flow. Solutions can be obtained for the entire transonic range, the transonic area rule being automatically obtained both in the first and second approximations. Furthermore, it is possible to determine the aerodynamic loads from a given pressure distribution on the equivalent body of revolution. Author

N70-42500# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
PRESSURE MEASUREMENTS ON A SLENDER RHOMBIC CONE AT INCIDENCE AT MACH NUMBERS FROM 0.4 TO 1.1
J. H. B. Smith and A. G. Kurn London Aeron. Res. Council 1970 37 p refs Supersedes RAE-TR-68171; ARC-30735 (ARC-R/M-3626; RAE-TR-68171; ARC-30735) Copyright. Avail: NTIS; HMSO: 19s; BIS: $3.60

Pressures were measured on a wing in the form of a rhombic cone at two cross-sections and along a single generator. The wing had an aspect ratio of one and a leading-edge angle of 60 deg. Measurements were made at M = 0.4, 0.6, 0.82, 0.9, 1.0 and 1.1, at angles of incidence up to 20 deg and at a Reynolds number of 6 million, based on model length. At the lowest Mach number the tests were repeated at higher Reynolds number. The measured pressure distributions are typical of flow with leading-edge vortices. Two different types of suction peaks were observed and associated, on indirect evidence, with the state of the boundary layer at secondary separation. Within each type, increasing Mach number reduced the magnitude of the peak suction, but had little effect on its spanwise location. At transonic and high subsonic speeds an increase in incidence above 8 deg changed the shape of the suction peak from the type associated with a turbulent secondary separation to that associated with a laminar one. Author (ESRO)

N70-42529# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
GUST RESPONSE MEASUREMENTS ON A MODEL AIRCRAFT
R. Cansdale and H. Hall London Aeron. Res. Council 1970 24 p refs Supersedes RAE-TR-69273; ARC-31966 (ARC-CP-1113; RAE-TR-69273; ARC-31966) Copyright. Avail: NTIS; HMSO: 7s; BIS: $1.40

Design studies of slender wing configurations showed that gust response might be a serious problem so a technique was developed for investigating the symmetrical response of a model aircraft to an up-gust using a sled propelled by rockets along a track past the mouth of an open-jet wind tunnel. Test results for a rigid slender wing model agreed well with calculations. Author (ESRO)

N70-42574*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF THREE REPRESENTATIVE HYPERSONIC CRUISE CONFIGURATIONS AT MACH NUMBERS FROM 0.65 TO 10.70
Walter P. Nelms, Jr. and John A. Axelson Washington Oct. 1970 87 p refs
(NASA-TM-X-2113) Avail: NTIS CSCL 01A

An experimental investigation of the aerodynamic characteristics of three representative hypersonic cruise configurations was conducted at Mach numbers from 0.65 to 10.70. The models were designed to the same general specifications for air-breathing, liquid-hydrogen-fueled, hypersonic cruise configurations; two were discrete wing-body concepts and the third resembled a blended wing-body design. This report examines the detailed effects of variations in angle of attack, Mach number, and configuration buildup on the longitudinal aerodynamic characteristics of the three models. Author

N70-42575*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME OBSERVATIONS OF EFFECTS OF POROUS CASINGS ON OPERATING RANGE OF A SINGLE AXIAL-FLOW COMPRESSOR ROTOR
Everett E. Bailey and Charles H. Voit Washington Oct. 1970 30 p refs
(NASA-TM-X-2120) Avail: NTIS CSCL 21E

The results of testing a single axial-flow rotor with several porous outer casings are presented. Comparative tests were made with tip radial inlet flow distortion. An improvement in the stable operating range of the rotor was noted for some of the porous casing configurations. Some loss in rotor performance was noted when a porous casing was present. Author

N70-42576*# Techtran Corp., Glen Burnie, Md.
UNSTEADY PRESSURE DISTRIBUTION MEASUREMENTS ON AN OSCILLATING WING AT SUBSONIC AND TRANSONIC SPEEDS [INSTATIONAERE DRUCKVERTEILUNGMESSUNGEN AN EINEM SCHWINGENDEN TRAGFLUEGEL IM SUBSONISCHEN UND TRANSSONISCHEN GESCHWINDDIGKEITSBEREICH]
H. Triebstein Washington Oct. 1970 29 p refs Transl. into ENGLISH from Deut. Forschungs (Germany), Jul. 1969 31 p
(Contract NASw-2037)
(NASA-TT-F-13337) Avail: NTIS CSCL 20D

A test stand for the measurement of unsteady pressure distributions in a transonic wind tunnel is described along with the test procedures. Results obtained in the speed range M = 0.5 to 1.2 for a rectangular wing performing pitching oscillations about different spanwise axes and control surface oscillations about the hinge axis are discussed and compared with theory. Good agreement was found in the subsonic region, whereas in the transonic region considerable differences appeared due to local shock waves and transonic buffeting. Finally, it is shown that the unsteady pressure amplitudes behave fairly linear with respect to the vibration amplitude as long as the angles of attack of the wing are relatively small. Author

N70-42737*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF WING ELEVATION, INCIDENCE, AND CAMBER ON THE AERODYNAMIC CHARACTERISTICS OF A REPRESENTATIVE HYPERSONIC CRUISE CONFIGURATION AT MACH NUMBERS FROM 0.65 TO 10.70

Walter P. Nelms, Jr. and John A. Axelson Washington Oct. 1970 77 p refs

(NASA-TN-D-6049; A-3701) Avail: NTIS CSCL 01A

A delta wing and body configuration representative of an airbreathing, liquid hydrogen fueled, hypersonic cruise aircraft was tested with the wing in high, mid, and low positions at zero incidence on the body, and the incidence angle was varied from −2 degrees to +2 degrees in the mid position. Wings with positive cambered, symmetrical, and negative cambered airfoil sections were studied for the mid position at zero incidence. The tests were conducted over a nominal angle of attack range from −4 degrees to +12 degrees, and angle of sideslip range from −4 degrees to +10 degrees. The results indicate that variations in wing elevation on the fuselage had little effect on the lift and pitching moment characteristics but had significant effects on the lateral and directional stability at most Mach numbers of the study. Changing wing incidence varied the pitching moment at zero lift over the entire test Mach number range with little or no reduction in the maximum lift drag ratio at supersonic and hypersonic speeds. At transonic and supersonic Mach numbers, wing camber significantly affected the pitching moment at zero lift but only slightly affected this parameter at hypersonic speeds. Author

N70-43015# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

LOW-SPEED WIND-TUNNEL TESTS ON AN UNSWEPT WING-FUSELAGE MODEL OF ASPECT RATIO 9.8, WITH TANGENTIAL BLOWING OVER TRAILING-EDGE FLAPS AND AILERONS, INCLUDING THE EFFECT OF SLIPSTREAM

J. A. Lawford London Aeron. Res. Council 1970 61 p refs Supersedes RAE-TR-68111; ARC-30636

(ARC-CP-1108; RAE-TR-68111; ARC-30636) Copyright. Avail: NTIS; HMSO: 16s; BIS: $3.20

Tests were made on an unswept, high-wing wing-fuselage model of aspect ratio 9.8, with boundary layer control by blowing at the shroud of trailing-edge flaps and ailerons. Propeller slipstream was represented during some of the tests. Critical blowing momentum coefficients ranging over 0.015 to 0.05 at flap angles of 30 deg and 60 deg respectively were determined. With slipstream, a critical coefficient defined in terms of slipstream velocity at the propeller disc was substantially independent of thrust coefficient. Increments of lift coefficient, without slipstream, due to a blowing momentum coefficient of 0.1, were 0.65 and 1.82 respectively at flap angles of 0 deg and 60 deg. Author (ESRO)

N70-43048# Glasgow Univ. (Scotland). Dept. of Aeronautics and Fluid Mechanics.

EXPERIMENTAL INVESTIGATION OF A HIGH-LIFT LOW-DRAG AEROFOIL

F. H. Kelling Sep. 1968 43 p refs

(Rept-6802) Avail: NTIS

One low drag airfoil was selected for low speed wind tunnel testing at Reynolds numbers around half a million. Coefficients of lift, drag and pitching moment were obtained for a range of incidence. The maximum section lift coefficient obtained was 1.93 and the minimum profile drag coefficient was 0.0112. Results compared favorably with those deduced theoretically. The addition of a boundary layer trip to the upper surface caused the profile drag to decrease at some incidences. At the design lift coefficient of 1.4, the ratio of lift to profile drag was 108 at a Reynolds number of 0.63 million. The addition of an extended, sealed, flat-plate flap (with a chord one tenth that of the airfoil) at the trailing edge of the airfoil gave favorable results. A maximum ratio of lift to profile drag of 116 was obtained at a lift coefficient of 1.8 with a flap deflection of 17.8 degrees, while the maximum lift coefficient achieved was 2.30. Author

N70-43087# National Physical Lab., Teddington (England). Aerodynamics Div.

INFLUENCE OF WING ROOT SHAPING ON THE PRESSURE DISTRIBUTION OF SWEPT-WING BODY CONFIGURATIONS

J. Bridgewater and K. H. Wilson London Aeron. Res. Council 1970 17 p refs Supersedes NPL-AERO-NOTE-1082; ARC-31311

(ARC-CP-1109; NPL-AERO-NOTE-1082; ARC-31311) Copyright. Avail: NTIS; HMSO: 5s; BIS $1.00

Swept wing pressure fields calculated by inviscid linearized theory are presented for symmetric wing-body configurations at Mach number 2. The effects of varying the inboard wing shape are investigated, with the aim of minimising the associated body waisting needed to achieve a desirable isobar pattern, and to produce a good overall area distribution. Author (ESRO)

N70-43141# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

AUTOROTATING WINGS: AN EXPERIMENTAL INVESTIGATION Interim Technical Report

Edmund H. Smith (Ph.D. Thesis) Jul. 1970 159 p refs

(Contract DAHC04-68-C-0027)

(AD-710288; Rept-01954-2-T; AROD-5590-4-E) Avail: NTIS CSCL 1/3

The autorotation of a flat plate about its spanwise axis was experimentally studied. Most of the work was done with a model mounted on air bearings in a wind tunnel. The flow pattern differed from that over a static wing. The wing did not stall until it was almost perpendicular to the free stream. At Re = 240,000, the maximum lift coefficient was 4.50, with an average value of 2.20, while the maximum drag coefficient was 4.30 with an average value of 1.60. The angular acceleration was small; the wing rotated at an almost constant angular velocity. The wing nondimensional rotation rate approached an asymptotic limit at 0.35. Applying a driving torque to the wing increased the lift and drag, while a retarding torque reduced them. A variety of wing configurations were tested, with no major changes in the autorotation phenomenon. Freely falling wings were studied and behaved in a manner similar to the fixed axis wings for comparable Reynolds numbers. Author (TAB)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N70-41851*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

TEMPERATURE MEASUREMENT INSIDE A JIMSPHERE BALLOON

Robert E. Turner, James B. Franklin (Lockheed Missiles and Space Co., Huntsville, Ala.), and Luke P. Gilchrist (Lockheed Missiles and Space Co., Huntsville, Ala.) 21 Aug. 1970 22 p ref

(NASA-TM-X-64547) Avail: NTIS CSCL 01C

An experiment was conducted to determine the difference

in the temperature inside a jimsphere balloon and the ambient temperature during actual free-flight of the jimsphere. The temperature inside the jimsphere was measured to determine the lapse rate of the helium temperature during normal flight conditions and to infer the effects that the balloon temperature may have on the ambient temperature. For this experiment, a standard AMT-4 radiosonde was used to measure the ambient temperature and the humidity circuit modified to accept a thermistor to measure the balloon temperature. Six flights were made, three of which were made in daylight and three under nighttime conditions. It was found that balloon temperature lapse rate was not so great as the ambient temperature lapse rate. At times, the balloon temperature was as much as 25 C higher than the ambient temperature during daylight flights. During nighttime, the departure was not nearly so great, with the balloon temperature being generally lower than the ambient temperature. Author

N70-41863* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLEXIBLE WING DEPLOYMENT DEVICE Patent
Charles E. Libbey, inventor (to NASA) Issued 22 Nov. 1966 (Filed 30 Jun. 1964) 8 p Cl. 244-16
(NASA-Case-XLA-01220; US-Patent-3,286,957;
US-Patent-Appl-SN-379417) Avail: US Patent Office CSCL 01C

A deployment system for a flexible wing with a rigid superstructure is described. The wing has a generally delta shaped planform and includes a nose section, keel, and leading edge members. The leading edge members are hinged to the nose so that they may fold back against the keel. The keel and leading edge members are constructed of telescoping sleeves which are collapsible for packaging and are self-locking upon extension. The telescoping sections of the keel and leading edge members are extended sequentially by a drogue parachute and deployment line severing mechanism. R.B.

N70-41985# General Accounting Office, Washington, D.C.
POTENTIAL FOR SAVINGS IN AIRCRAFT MAINTENANCE: DEPARTMENT OF THE NAVY AND DEPARTMENT OF THE AIR FORCE B-152600
7 May 1970 37 p
Avail: Issuing Activity

The Army and the Navy spend approximately $5.5 billion annually to keep their aircraft in operation. Previous work revealed a difference in practices and procedures for the two services which initiated a review to evaluate and compare the way the two services schedule maintenance but did not attempt to evaluate the quality or the effectiveness of the maintenance performed. The review included both organizational maintenance performed by the operating units on a day-to-day basis in support of their own operations and depot-level maintenance by a special facility which provides more comprehensive inspection and overhaul. The review is based on the F-4, a supersonic all-weather aircraft. It was found that the Navy could show a savings if it adopted the Air Force practice of using flight hours for performing organizational inspections and maintenance rather than elapse days. Author

N70-42013# Douglas Aircraft Co., Inc., Long Beach, Calif.
A FLIGHT SIMULATOR STUDY OF STOL TRANSPORT LATERAL CONTROL CHARACTERISTICS Final Report
Douglas E. Drake, Robert A. Berg, Gary L. Teper, and W. Allen Shirley Sep. 1970 123 p refs
(Contract FA69WA-2186)
(FAA-RD-70-61) Avail: NTIS

A systematic investigation was conducted of STOL transport terminal area lateral control characteristics to identify the significant considerations and establish appropriate lateral control criteria. The investigation consisted of an analysis of applicable existing data and a moving-base flight simulator test program using the NASA Ames Research Center S-16 Moving Cab Transport Simulator. The flight simulator program covered a wide range of vehicle aerodynamic and physical characteristics representative of practical STOL transports ranging in size from 25,000 to 130,000 pounds. Author

N70-42016* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DOUBLE HINGED FLAP Patent
Thomas R. Turner, inventor (to NASA) Issued 23 May 1967 (Filed 31 Aug. 1964) 5 p Cl. 244-42
(NASA-Case-XLA-01290; US-Patent-3,321,157;
US-Patent-Appl-SN-393451) Avail: US Patent Office CSCL 01C

A mechanism for boundary layer control over a wing having multiple flap segments is described. The flap comprises two segments individually pivoted to the wing and having a narrow slot between the upper segment and the wing. Release of a high pressure fluid from the slot controls the boundary layer and flow separation over the aft portion of the wing surface. Blowing high pressure air from the slot with the flap undeflected reduces separation over the aft portion of the airfoil, resulting in a higher lift-to-drag ratio for more economical cruising. Blowing air from the same slot with the flap partially or fully deflected increases the lift for takeoff and landing. R.B.

N70-42037*# Serendipity, Inc., Sherman Oaks, Calif.
A SIMULATOR STUDY OF FLIGHT MANAGEMENT TASK PERFORMANCE DURING LOW VISIBILITY APPROACH AND LANDING USING BASELINE CATEGORY 2 FLIGHT INSTRUMENTATION
Walter B. Gartner Dec. 1969 153 p refs
(Contract NAS2-4406)
(NASA-CR-73478) Avail: NTIS CSCL 01D

The investigation was focused on the command pilot's ability to judge his approach to the authorized Category 2 minimum decision altitude (100 feet above the runway) and on the effects of various flight path offset conditions at this decision height on his ability to carry out the landing maneuver. Twelve currently active senior airline pilots, individually certified for Category 2 operations, flew a total of 252 approach and landing sequences under simulated Category 2 visibility conditions (1200- and 1600-feet RVR) and data was taken on the accuracy of selected estimates and judgments of the flight situation. The approach sequences were flown under various combinations of three alternative pilot operating procedures and three different flight control modes to determine the effects of these variables on the accuracy of flight progress judgments. The data obtained support the contention that baseline flight instrumentation will be inadequate for accurate monitoring and assessment of the approach to Category 2 operating minimums. Author

N70-42217# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
THE EFFECTS OF TEMPORAL AND SPECTRAL COMBINATIONS ON THE JUDGED NOISINESS OF AIRCRAFT SOUNDS Final Report
Karl S. Pearsons and Ricarda L. Bennett Jun. 1969 81 p refs
(Contract FA68WA-1978)
(FAA-NO-69-3) Avail: NTIS

Three test series were performed in an anechoic chamber using 20 college students to determine the judged noisiness of stimuli varying both temporally and spectrally. The first test series used 30 stimuli with 6 time patterns and 5 spectra. The second test used stimuli selected from the first test but modified to include signal durations ranging from 1 to 100 seconds. Duration in this case is the amount of time the stimuli were within 10 db of the maximum level. The stimuli for the third test consisted of recordings of turboprop, turbofan, turbojet, and helicopter flyovers. The results indicate that the most accurate predictor of the judged noisiness

is perceived noise level using a tone correction and an integrated measure of duration. To illustrate the improvement in noisiness predicability of EPNL over PNL, the results of the duration test are used. For this test, 75% of the data was within 4 db of the standard for EPNL with the FAA tone and integrated duration measure as compared to 11 db for PNL. Author

N70-42218# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
NOISE EXPOSURE FORECASTS: EVOLUTION, EVALUATION, EXTENSIONS, AND LAND USE INTERPRETATIONS Final Report
William J. Galloway and Dwight E. Bishop Aug. 1970 79 p refs
(Contract FA-68-WA-1900)
(FAA-NO-70-9) Avail: NTIS

The evolution is described of methods for relating aircraft noise exposure to community response, starting with the original Composite Noise Rating (CNR) concept. The development of CNR procedures for civil and military aircraft utilizing perceived noise level contours and the development of Noise Exposure Forecast (NEF) procedures utilizing effective perceived noise level data are compared. The CNR and NEF procedures are also related to various noise exposure indices developed in other countries. Cross comparisons of the indices allows verification of the numerical values and descriptors used in the CNR and NEF zones for land uses. The noise exposure due to aircraft operations is interpreted as expressed in NEF values, in terms of estimated impact on land uses. Assessments of the land use compatibility with aircraft noise as a function of NEF values are given for land uses provide guides in land use planning, zoning, development, and building construction. To provide for flexibility in setting descriptor limits to fit particular local conditions, the NEF values of the compatibility descriptors boundaries overlap, providing a range of NEF values where boundary limits may be modified by local considerations. Author

N70-42219# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
NOISE EXPOSURE FORECAST CONTOURS FOR 1967, 1970, AND 1975 OPERATIONS AT SELECTED AIRPORTS Final Report
Dwight E. Bishop and Myles A. Simpson Sep. 1970 269 p refs
(Contract FA-68-WA-1900)
(FAA-NO-70-8) Avail: NTIS

Noise Exposure Forecast (NEF) contours resulting from 1967, 1970, and 1975 aircraft operations are depicted for 28 airports. Included are contours for large, medium, and small commercial airports, and general aviation airports. The NEF contours define land areas having different land-use compatibility with respect to aircraft noise; hence, the NEF areas may be used as a guide to land-use planning and zoning and airport development. The NEF contours are based upon the aircraft noise described in terms of effective perceived noise levels (which includes corrections for duration and presence of discrete frequencies) plus adjustments for the number of operations for day-time and nighttime periods. Author

N70-42386# Royal Aircraft Establishment, Farnborough (England).
HYBRID COMPUTER PROGRAMME FOR PARAMETER OPTIMISATION OF FLIGHT CONTROL SYSTEMS
F. R. Gill and A. M. Whitehead Mar. 1970 59 p refs
(RAE-TR-70043) Copyright. Avail: NTIS

A hybrid program for the parameter optimization of flight control systems is described. Hill climbing procedures, with particular reference to gradient methods, were used in its development. The I.L.S. glide-path autopilot mode for the Hunter aircraft with electrically signalled flying controls was used as an example. Author (ESRO)

N70-42404# Federal Aviation Administration, Washington, D.C.
ANTICOLLISION LIGHTS FOR THE SUPERSONIC TRANSPORT (SST)
Siegfried J. Gerathewohl, Everett W. Morris, and Joseph A. Sirkis May 1970 27 p refs
(FAA-AM-70-9) Avail: NTIS

For visual detection at night, the aircraft must display conspicuous light signals to indicate its presence and course at sufficient distance and time remaining for the pilot to avoid a collision. Considerations about the usefulness of anticollision lights must include such factors as effective light intensity, color, flashing characteristics, field of coverage, and visual detection range as well as flying speed, airplane response, and the pilot's capability to avoid a collision. Results of simulator experiments indicate that the pilot can take evasive actions at relatively high closing speeds under daylight conditions, but no data are available about collision avoidance at night. Author

N70-42407# Commerce Dept., Washington, D.C. Business and Defense Services.
WORLD SURVEY OF CIVIL AVIATION: CANADA
GPO Jun. 1970 47 p *Its* Ser. No. 20
Avail: SOD $0.30

A market survey of civil aircraft and aeronautical products is presented with an evaluation of the role of air transportation in Canada. Fleet composition, flight operations, marketing and investment opportunities are discussed. The Canadian aerospace industry, which is the fourth largest in the free world, and the government support furnished the industry are described. The survey is designed to contribute marketing information which will enhance U.S. ability to maintain its position as worldwide leader in the aerospace industry. Author

N70-42430# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
REAL-TIME SIMULATION OF AIRCRAFT USING DIGITAL COMPUTERS [ECHTZEIT-SIMULATION VON FLUGZEUGEN MIT DIGITALRECHNERN]
Rudolf Dierke Jun. 1970 52 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-21) Avail: NTIS; ZLDI Munich: 11.50 DM

A time-optimal program for digital aircraft simulation was developed and body-axes were used as the coordinate system for describing the aeroplane in free flight. Quaternions proved to be best method for computing the aircraft attitude. The digital presentation of nonlinear functions is briefly discussed and suitable integration methods for real-time simulation are given. The use of stability cards for estimating the asymptotic behaviour of an integration method (after a high number of steps) is discussed. Author (ESRO)

N70-42532# Aberdeen Proving Ground, Md. Human Engineering Labs.
METHODOLOGY FOR A TACTICAL UTILITY HELICOPTER INFORMATION TRANSFER STUDY
John A. Barnes May 1970 15 p refs
(AD-710248; HEL-TN-4-70) Avail: NTIS CSCL 1/4

The study was an effort to determine what information, available from basic flight instruments, was used by the pilot to perform the various missions that encompass the tactical utility helicopter mission. A UH-1 aircraft, the current U. S. Army tactical utility helicopter, was used as the test vehicle and all measures relate to this vehicle. Author (TAB)

N70-42738*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT EVALUATION OF GROUND EFFECT ON SEVERAL LOW-ASPECT-RATIO AIRPLANES
Paul A. Baker, William G. Schweikhard, and William R. Young Washington Oct. 1970 48 p refs
(NASA-TN-D-6053; H-550) Avail: NTIS CSCL 01A

A constant angle of attack approach technique was used to measure ground effect on several low aspect ratio aircraft. The flight results were compared with results from constant altitude flybys, wind tunnel studies, and theoretical prediction data. It was found that the constant angle of attack technique provided data that were consistent with data obtained from constant altitude flybys and required fewer runs to obtain the same amount of data. The test results from an F5D-1 airplane modified with an ogee wing, a prototype F5D-1 airplane, two XB-70 airplanes, and an F-104A airplane indicate that theory and wind tunnel results adequately predict the trends caused by ground effect as a function of height and aspect ratio. However, the magnitude of these predictions did not always agree with the flight-measured results. In addition, there was consistent evidence that the aircraft encountered ground effect at a height above one wing span. Author

N70-42770# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
AN INFLATED MOBILE LIFTING SYSTEM FOR AN 8 TON LOAD
I. S. H. Brown and F. T. Kierton London Aeron. Res. Council 1970 24 p refs Supersedes RAE-TR-67190; ARC-29789
(ARC-CP-1092; RAE-TR-67190; ARC-29789) Copyright. Avail: NTIS; HMSO: 6s; BIS: $1.20

A system comprising an inflatable load-lifting canopy of oval planform with buoyancy tube and separate trailer for inflation and towing over water proved feasible for loads of up to 8 tons over smooth ground and calm water. Performance limits in more severe conditions were not determined. The device can be used for transporting heavy machinery and raising and recovering objects, including aircraft, from mud, water, sand, etc. Author (ESRO)

N70-42810*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PILOTED SIMULATOR INVESTIGATION OF GROUND EFFECT ON THE LANDING MANEUVER OF A LARGE, TAILLESS, DELTA-WING AIRPLANE
C. Thomas Snyder, Fred J. Drinkwater, III, and A. David Jones Washington Oct. 1970 48 p refs Prepared in cooperation with Army Aeronautical Res. Lab.
(NASA-TN-D-6046; A-3171) Avail: NTIS CSCL 01B

The influence of ground effect on the landing flare characteristics of a supersonic transport airplane (SST) was investigated in a fixed cockpit simulator. Simulations of an ogee-modified delta-wing F5D-1 airplane and a subsonic jet transport were used for evaluating the simulator and as reference configurations during landing comparisons. Dynamic responses of the SST to seven different ground-effect models during controls-fixed and constant-attitude descents are also presented, followed by piloted subjective assessments. A summary of ground effects on delta-like wings is included in the appendixes. Author

N70-42828*# Techtran Corp., Glen Burnie, Md.
DISCRETE COMPONENT IN NOISE SPECTRUM OF SUPERSONIC JETS [DISKRETNAYA SOSTAVLYAYUSHCHAYA V SPEKTRE SHUMA SVERKHZVUKOVYKH STRUY]
V. M. Anufriyev et al Washington NASA Oct. 1970 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidk. Gaza (Moscow), no. 5, Sep.–Oct. 1969 p 162–165
(Contract NASw-2037)
(NASA-TT-F-13270) Avail: NTIS CSCL 01B

Tests are conducted on various types of nozzles with various flow parameters to determine the discrete component in the noise spectrum of supersonic jets. The experimental apparatus and procedures are described and the experimental data are analyzed. It is concluded that at some distance from the nozzle exit the stationary flow in the jet becomes unstable, and that this part of the jet becomes a powerful source of discrete components in the total noise spectrum of the jet. Author

N70-43030# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
A NEW APPROACH TO THE SPECIFICATION AND EVALUATION OF FLYING QUALITIES Final Report
Ronald O. Anderson Jun. 1970 74 p refs
(AD-710590; AFFDL-TR-69-120) Avail: NTIS CSCL 1/3

A study of the correlation of pilot model parameters and closed-loop performance with pilot opinion of VTOL hover dynamics was conducted. The encouraging results suggested a pilot-vehicle analysis method of predicting pilot model parameters, closed-loop pilot-vehicle performance with gust inputs, and pilot opinion ratings for a wide range of vehicle dynamics. This approach was, in turn, used to predict ratings for comparison with fixed base, moving base, and flight test results for VFR conditions. Again the results were promising, and a new method of specifying hover dynamics followed naturally. The new pilot-vehicle analysis concept, called the minimum pilot rating method, is discussed in terms of applications to other tasks, flying qualities specification, and control system design. Author (TAB)

N70-43132# Hughes Tool Co., Culver City, Calif. Aircraft Div.
ROTOR/WING Final Technical Report
F. J. Briardy, S. V. LaForge, and J. R. Neff Mar. 1970 79 p refs
(Contract Nonr-4588(00))
(AD-710425; HTC-AD-69-12A) Avail: NTIS CSCL 1/3

The report presents the technical status of the rotor/wing concept of a stopped-rotor helicopter configuration. The configuration presents attractive performance characteristics for a high-speed VTOL aircraft. The ability to predict aerodynamic performance characteristics in all flight modes is substantiated by wind-tunnel tests. A major technical problem of 3-per-rev oscillating loads on the rotor/wing pylon was minimized by the effective use of cyclic blade pitch during the high-advance-ratio portion of conversion. High values of oscillating blade-root moments were recorded during testing of a dynamic model. It is not known if there is a schedule of cyclic pitch that will minimize both pylon loads and blade-root loads simultaneously. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N70-41864*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PREVENTION OF PRESSURE BUILD-UP IN ELECTROCHEMICAL CELLS Patent
Thomas J. Hennigan, Paul C. Donnelly, and Charles F. Palandati, Jr., inventors (to NASA) Issued 22 Nov. 1966 (Filed 12 Nov. 1963) 4 p Cl. 136-179
(NASA-Case-XGS-01419; US-Patent-3,287,174; US-Patent-Appl-SN-323182) Avail: US Patent Office CSCL 10B

A method is described in which powdered palladium oxide confined inside electrochemical cells reacts with the hydrogen evolved in the cells to form water and palladium. The removal of the hydrogen gas through reaction with the palladium oxide prevents pressure buildup in the cells. R.B.

N70-41889*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSIENT CHARACTERISTICS OF A VOLTAGE REGULATOR AND A PARASITIC SPEED CONTROLLER ON A 14.3-KILOVOLT-AMPERE, 1200-HERTZ MODIFIED LUNDELL ALTERNATOR
Heinz L. Wimmer and Bill D. Ingle Washington Oct. 1970 26 p refs
(NASA-TN-D-5925; E-5626) Avail: NTIS CSCL 09E

The transient performances of a voltage regulator and a parasitic speed controller on a turbine-driven alternator were determined experimentally. The voltage regulator and the speed controller were developmental components for use in a 10-kilowatt, 1200-hertz Brayton-cycle space power generating system. Voltage excursions, voltage recovery times, and frequency recovery times were well within design goals. Frequency excursions exceeded the design goal by a small amount. Author

N70-41903*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVEMENTS IN SILICON SOLAR CELL COVER GLASS ASSEMBLY AND PACKAGING USING FEP TEFLON
A. F. Forestieri and J. D. Broder Jul. 1970 14 p refs
(NASA-TM-X-52875) Avail: NTIS CSCL 10B

Two techniques are described for improving silicon solar cell cover glass assembly and packaging by the use of FEP Teflon. One method utilizes Teflon as an adhesive for cementing standard cover glasses to the silicon solar cells. Because of the resistance of the Teflon to UV radiation, the UV filter on the cover glass can be eliminated. Also, labor for mounting the cover glass is reduced. Covered cells produced in this manner are more readily fabricated and have a slightly higher power output initially as compared with cells produced by present techniques. The second method utilizes Teflon both as the cover material and as an adhesive for mounting the solar cells to a flexible substrate. A significant decrease in cost is anticipated for arrays fabricated in this manner. Some of the characteristics of a completed array would be: lightweight, flexible, insulated, completely sealed and breakage resistant. Author

N70-41954* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROPORTIONAL CONTROLLER Patent
Earl O. Menefee, inventor (to NASA) Issued 21 Feb. 1967 (Filed 5 Feb. 1965) 10 p Cl. 74-519
(NASA-Case-XAC-03392; US-Patent-3,304,799; US-Patent-Appl-SN-430776) Avail: US Patent Office CSCL 13I

A proportional controller for regulating motion about three axes is described. The device consists of a support frame and a handle connnected by three flexural pivot members. Each of the flexural pivot members comprises two attachment sections and one interconnecting member. The roll axis is provided by the center line of one of the pivot members connected to the support frame. The yaw axis is provided by another of the pivot members connected to the first member. The third pivot member provides the pitch axis by being connected to the second member. A strain gage or equivalent electrical device for detecting bending is attached to each of the flexural members. The electrical signals from the strain gages are converted into the desired movement of control mechanisms, and the resulting control movements are proportional to the amount of movement of the handle. R.B.

N70-42073* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
TWO-AXIS CONTROLLER Patent
Richard O. Musick, Robert R. Ballard, and William L. Robertson, inventors (to NASA) Issued 6 Jun. 1967 (Filed 2 Aug. 1965) 6 p Cl. 74-471
(NASA-Case-XFR-04104; US-Patent-3,323,386; US-Patent-Appl-SN-476759) Avail: US Patent Office CSCL 13I

A flight control device or joystick mechanism is described which utilizes a pair of potentiometers with control shafts directly coupled to a rotatable ball member, a construction which reduces the size and complexity of the mechanism. The ball member has a plurality of slots and a slideway; the slide member also includes a slot. This slot and one of the ones formed in the ball member each receive a control shaft of a potentiometer mounted in a suitable position in the support structure. Each output shaft can then be rotated to vary the potentiometer output by rotation of the ball member about its center. P.A.B.

N70-42202*# TRW Equipment Labs., Cleveland, Ohio. Power Systems Dept.
BRAYTON CYCLE CAVITY RECEIVER DESIGN STUDY
22 Nov. 1965 325 p refs
(Contract NAS3-2779)
(NASA-CR-54752) Avail: NTIS CSCL 10B

Studies leading to the design and development of solar dynamic power conversion systems which operate on the Brayton cycle are discussed. A design study of cavity-type receivers which employ lithium fluoride as the heat storage medium was conducted. Design and analysis of full scale flightweight receivers, conduction of a series of small scale experiments, and an experimental corrosion properties investigation on selected materials were completed. The results of the full scale design studies and of the small scale experiments are presented. Author

N70-42211*# Eagle-Picher Co., Joplin, Mo. Electronics Div.
STUDY OF PROCESS VARIABLES ASSOCIATED WITH MANUFACTURING HERMETICALLY-SEALED NICKEL-CADMIUM CELLS Quarterly Report, 23 Feb.–23 May 1970
William C. Harsch and Donald J. Doan Sep. 1970 86 p refs
(Contract NAS5-21159)
(NASA-CR-114261; QR-1) Avail: NTIS CSCL 10C

The first phase of experiments designed to determine the critical process variables in the manufacturing of aerospace nickel-cadmium cells is described. The first phase was devoted to the dry-sintering process for manufacturing porous nickel plaques. The results presented are the effects of sintering time and temperature, atmosphere composition and cooling method. The plaques were characterized by thickness, porosity, free volume, strength and weight. Unit weight, thickness and strength were also taken to determine uniformity within each plaque as well as from plaque-to-plaque. Author

N70-42337*# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. Electrotechnology Lab.
USE OF DIRECT CURRENT VOLTAGE CONVERTER TO MAINTAIN CONSTANT 27.5 VOLT TERMINAL VOLTAGE FROM LEAD ACID BATTERY POWER SUPPLY
George M. Lange Jun. 1970 32 p refs
(AD-710249; USAMERDC-1981) Avail: NTIS CSCL 10/2

The report covers an investigation of the use of an engineering design model voltage converter to maintain a 27.5-volt terminal voltage from lead acid batteries varying in voltage from 24 to 20 volts. The report concludes that: (a) A direct-current voltage converter can maintain a 27.5-volt terminal voltage from a lead acid battery source varying in voltage from 24 to 20 volts; (b) A direct-current voltage converter and 24-volt lead acid batteries in parallel with a 28-volt, direct-current, engine-driven automotive alternator or generator set provides a no-break power supply that will permit shutting down the engine-driven unit for maintenance or service without any variation in system terminal voltage; (c) The combination of lead acid batteries and a direct-current voltage converter can act

as peaking power to carry momentary surge leads or 100-percent overloads on an alternator or generator set for short periods, permitting the use of a smaller engine-driven unit than would otherwise be required. Author (TAB)

N70-42351*# Eagle-Picher Co., Joplin, Mo. Couples Dept.
STUDY OF PROCESS VARIABLES ASSOCIATED WITH MANUFACTURING HERMETICALLY-SEALED NICKEL-CADMIUM CELLS Quarterly Report, 23 Feb.–23 May 1970
William C. Harsch and Donald J. Doan Sep. 1970 65 p refs
(Contract NAS5-21159)
(NASA-CR-110797; QR-1) Avail: NTIS CSCL 10C

The first phase of experiments designed to determine the critical process variables in the manufacture of aerospace nickel-cadmium cells is described. The dry-sintering process for manufacturing porous nickel plaques is discussed. The results presented are the effects of sintering time and temperature, atmosphere composition, and cooling method. The plaques are characterized by thickness, porosity, free volume, strength, and weight. Unit weight, thickness, and strength were also taken to determine uniformity within each plaque as well as from plaque-to-plaque. Author

N70-42359*# Oak Ridge National Lab., Tenn.
FILLING HEAT STORAGE TUBES FOR SOLAR BRAYTON-CYCLE HEAT RECEIVER WITH LITHIUM FLUORIDE
P. A. Gnadt Jul. 1970 90 p refs
(NASA Order C-90089-A; Contract W-7405-eng-26)
(NASA-CR-110776; ORNL-TM-2732) Avail: NTIS CSCL 10B

A facility was designed, fabricated, and operated to fill columbium-1% zirconium tubes with liquid lithium fluoride. Sixty-nine heat storage tubes were processed for a solar heat receiver that is a major component of a solar heated Brayton cycle power unit to be used for earth orbit application. The lithium fluoride was introduced into the annulus between a bellows-like outer tube and an inner gas duct that will carry the Brayton cycle working fluid, a helium-xenon mixture. The 48 columbium-1% zirconium tubes required for the actual system were filled with the molten salt, as well as eleven spares, six heat transfer test specimens, three thermal cycling test specimens, and one preliminary test piece. The process required the use of a 120 cu ft, 10 ft high vacuum chamber, refractory metal jigs and fixtures, highly purified lithium fluoride at temperatures up to 1750 F, and much of the sophisticated technology developed for the handling of high melting point salts (LiF m.p. = 1560 F). Author

N70-42409*# Bureau of Mines, Pittsburgh, Pa. Pittsburgh Coal Research Center.
INTERSTITIAL COMPOUNDS AS FUEL CELL CATALYSTS: THEIR PREPARATIVE TECHNIQUES AND ELECTROCHEMICAL TESTING
S. Akhtar, C. T. Grein, and D. Bienstock Washington 1970 64 p refs
(NASA Order W-12300)
(NASA-CR-110835; BM-BULL-652) Avail: NTIS CSCL 10B

Interstitial compounds of iron, cobalt, and nickel, and their binary and ternary mixtures with silver, gold, palladium, and platinum were prepared and tested as fuel cell catalysts. The first step in the preparation of the interstitial compounds consisted of preparing finely divided metals. This was done either by the Raney method or by reduction of precipitated hydroxides of the metals. The finely divided reduced metals were than treated with carbon and/or nitrogen-containing gases to prepare their carbides, nitrides, and nitrocarbides. The materials were tested for cathodic activity towards O2 and for anodic activity towards H2, C3H8, NH3, CO, and N2H4 in acid and alkaline electrolytes at 25 to 90 C in half-cell assemblies. Samples of carbided and nitrocarbided 1Ni-1Ag-1Au were about one fifth as active as Pt-black in the reduction of O2 in 35 percent KOH solution, whereas the activities of several interstitial preparations exceeded the activity of Pt-black in the reduction of O2 in 12M KOH containing N2H4. Nitrocarbides of chi-Fe2C, 3Ni-1Au, and 1Ni-3Au were effective catalysts for oxidizing N2H4 in liquid NH3 containing NH4SCN. Corrosion of the catalysts by electrolytes was severe in many cases. Author

N70-42424*# Electric Storage Battery Co., Yardley, Pa.
ALKALINE BATTERY SEPARATORS CHARACTERIZATION STUDIES Quarterly Report
[1970] 88 p refs
(Contract NAS5-10418)
(NASA-CR-110773; QR-6) Avail: NTIS CSCL 10C

Permion 1770C, 2290, and 2291 showed the best overall balance of properties in bench characterization testing of separator materials for silver-zinc batteries. Both non-battery and three-plate cell data were evaluated for fifteen film type separators. Based on this test program, the following characteristics were used to choose the above films for battery testing: (1) electrical resistance in 40 percent KOH less than 1.0 ohms-sq cm, (2) zinc diffusion rates through the film, less than 1 times 10 to the minus 8th power moles Zn/sq cm sec, (3) zinc penetration value greater than 3, (4) a minimum of 30 cycles in silver-cadmium and nickel-zinc laboratory cell tests, and (5) no loss in physical properties on exposure to 40 percent KOH saturated with Ag2O and ZnO. Absorbent type separators were also examined for physical and chemical properties relevant to use in silver zinc batteries. Significant variation in wetting properties exists among the absorbers, but the effect of this variation was not evinced in the cell testing where flooded conditions were used. Author

N70-42477*# Boeing Co., Seattle, Wash.
INVESTIGATION INTO THE MECHANISM OF DEGRADUATION OF SOLAR CELLS WITH SILVER-TITANIUM CONTACTS Final Report
Charles J. Bishop and Henry Oman 1 Jul. 1970 83 p refs
(Contract NASw-1859)
(NASA-CR-111768; D2-126194-3) Avail: NTIS CSCL 10B

Electrochemical tests and physical measurements were used to characterize the degradation process. Physical measurements included optical and electron micrographs, X-ray diffraction, electron microprobe, mass spectroscopy, and internal reflection spectroscopy. Author

N70-42562# Battelle Inst., Frankfurt am Main (West Germany).
[THIN-FILM SOLAR CELLS]
R. Ziegler (Ges. fuer Weltraumforsch.), W. Ruppel (Karlsruhe Univ.), G. Guettler (Frankfurt Univ.), H. J. Queisser (Frankfurt Univ.), K. K. Reinhartz (ESTEC) et al *In its* Battelle Inform. No. 5 Aug. 1969 p 48–54 (See N70-42557 24-34) Colloq. held at Frankfurt, 23–24 Jan. 1969
Avail: NTIS

Photovoltages at interfaces, deep impurity effects and graded energy gaps are discussed in relation to thin-film solar cells using cadmium, tellurium, indium and phosphorus compounds. ESRO

N70-42732*# Philco-Ford Corp., Palo Alto, Calif. WDL Div.
ENGINEERING EXPERIMENTAL PROGRAM ON THE EFFECTS OF NEAR-SPACE RADIATION ON LITHIUM-DOPED SOLAR CELLS Semiannual Report, 2 Jul. 1969–30 Apr. 1970
1 Jun. 1970 54 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952585)
(NASA-CR-110885; WDL-TR-4213) Avail: NTIS CSCL 10B

A summary is presented of a program to experimentally evaluate the real-time degradation characteristics of lithium-diffused silicon solar cells. A strontium-90 radioisotope was used for simulation of

a typical earth orbital electron environment, both from spectral and flux rate viewpoints. The experiment was performed in an ion pump vacuum chamber with samples maintained at specified temperatures. Samples were illuminated during a six-month exposure run with solar cell 1-5 characteristics measured in situ. The solar cell samples were chosen on the basis of results gained from previous lithium cell development programs. This report describes the design of the experimental equipment and the sample matrix. Author

N70-42734# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SCIENTIFIC-TECHNICAL CONFERENCE ON HOMOPOLAR GENERATORS

B. L. Alievskii 15 May 1970 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Elektromekhan. (Novocherkassk), no. 7, 1969 p 802-804
(AD-710255; FTD-HT-23-250-70) Avail: NTIS CSCL 10/2

At a conference on homopolar generators, 35 reports were heard and discussed. Some of the topics covered were the questions of generator design theory, descriptions of the latest homopolar generator designs and special types, the problem of sliding contacts, merits of these generators and their practical prospects in electrochemical and electrical engineering industries. Author (TAB)

N70-42753# Federal Aviation Administration, Washington, D.C. Engineering and Manufacturing Div.

SECOND CONFERENCE ON FUEL SYSTEM FIRE SAFETY

May 1970 203 p refs Conf. held at Washington, D.C., 6-7 May 1970
(AD-711059) Avail: NTIS CSCL 13/12

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5. FUEL TANK INERTING USING CATALYTIC COMBUSTION TECHNIQUES R. G. Clodfelter (AFSC, Wright-Patterson AFB) p 141-169 refs (See N70-42758 24-03)

6. LIGHTNING INDUCED VOLTAGES IN ELECTRICAL CIRCUITS ASSOCIATED WITH AIRCRAFT FUEL SYSTEMS J. A. Plumer (GE, Pittsfield, Mass.) p 171-191 refs (See N70-42759 24-03)

7. FAA DC-9 LIQUID NITROGEN FUEL TANK INERTING PROGRAM T. G. Horeff p 193-203 (See N70-42760 24-03)

N70-42754# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

USAF EXPERIENCE WITH POLYURETHANE FOAM INERTING MATERIAL

Thomas O. Reed *In* FAA 2d Conf. on Fuel System Fire Safety May 1970 p 25-73 refs (See N70-42753 24-03)
Avail: NTIS CSCL 13/12

An outline of the Air Force's experience to date with reticulated polyurethane foam as an inerting material in the fuel tanks of combat aircraft is presented. Background data and experience on the present fully packed concept is included, as well as an outline of the efforts underway to reduce the weight and range penalties associated with the present foam through the use of low density foams and voiding concepts. Author

N70-42755# Military Airlift Command, Washington, D.C.

USAF, C141 AND C-135 FUEL TANK NITROGEN INERTING TESTS

William O. Brookley *In* FAA 2d Conf. on Fuel System Fire Safety May 1970 p 75-83 (See N70-42753 24-03)
Avail: NTIS CSCL 13/12

A summary of the C-141 and C-135 fuel tank nitrogen inerting tests and, test results obtained to this time is presented. An explanation of instrumentation installation and operation is presented. Tests were established to show proper operation of the components and systems and to prove that in no way could safety of flight of the aircraft be jeopardized by the inerting systems. This included normal operations, any type of failure or by affecting aircraft components or structure. Emphasis was placed on the testing of the vent valve since it was the most critical component in the system and was a newly designed component. Failure of the climb or dive valves to open due to ice was considered the most serious problem. Several severe icing tests were performed to verify that the design was sufficient to prevent failure from icing. Author

N70-42756# Bureau of Mines, Pittsburgh, Pa. Safety Research Center.

OXYGEN DILUTION REQUIREMENTS FOR INERTING AIRCRAFT FUEL TANKS

Joseph M. Kuchta *In* FAA 2d Conf. on Fuel System Fire Safety May 1970 p 85-115 refs (See N70-42753 24-03)
Avail: NTIS CSCL 13/12

The effectiveness of various inerting agents to prevent ignition and flame propagation are reviewed for hydrocarbon fuel-air systems. Data are presented on the variation of limits of flammability, minimum ignition energies, and minimum autoignition temperatures (AIT's) with oxidant or diluent concentration. The potential explosion hazard that may be encountered over a range of flight temperatures and pressures is discussed, and guidelines are given for specifying safe oxygen concentrations for aircraft fuel tanks. Author

N70-42757# National Aviation Facilities Experimental Center, Atlantic City, N.J.

IN-FLIGHT CONTROL OF POWERPLANT FIRES WITH LIQUID NITROGEN

Eugene P. Klueg *In* FAA 2d Conf. on Fuel System Fire Safety May 1970 p 117-139 (See N70-42753 24-03)
Avail: NTIS CSCL 13/12

The development, design, and criteria evaluation by experimentally establishing the requirements for an effective extinguishing system as influenced by nacelle ventilation and free volume and in terms of agent quantity, discharge rate, discharge conditions and distribution provisions are studied. The effects of an inadvertent discharge, damaged cowling, and the cooling of potential reignition sources are also being investigated under this phase. The work summarizes the findings to date resulting from these efforts and discusses current areas of investigation. Author

N70-42758# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Aero Propulsion Lab.

FUEL TANK INERTING USING CATALYTIC COMBUSTION TECHNIQUES

Robert G. Clodfelter *In* FAA 2d Conf. on Fuel System Fire Safety May 1970 p 141-169 refs (See N70-42753 24-03)
Avail: NTIS CSCL 13/12

The catalytic combustion technique for inerting of aircraft fuel systems is discussed. The catalytic combustion approach offers potential advantages over other combustion concepts by providing efficient oxygen conversion over a wide range of operating conditions with the generation of only a small amount of corrosive reaction products. The qualitative advantage of lower operating temperature and no combustion flame is also considered. Author

N70-42759*# General Electric Co., Pittsfield, Mass. High Voltage Lab.
LIGHTNING INDUCED VOLTAGES IN ELECTRICAL CIRCUITS ASSOCIATED WITH AIRCRAFT FUEL SYSTEMS
J. A. Plumer *In* FAA 2d Conf. on Fuel System Fire Safety May 1970 p 171–191 refs (See N70-42753 24-03)
(Contract NAS3-12019)
Avail: NTIS CSCL 21B

The characteristics of induced voltages in representative types of aircraft electrical circuits were studied by a series of measurements of lightning-induced voltages in the fuel system electrical circuits within the wing of an aircraft. From these measurements, mathematical expressions for these voltages were derived, relating them to the causative lightning current parameters. Further analysis of the possible effects of these induced voltages upon the fuel system is presented. The experimental procedures and results, as well as the analysis of possible effects on the fuel system are discussed. Author

N70-42760# Federal Aviation Administration, Washington, D.C. Engineering and Safety Div.
FAA DC-9 LIQUID NITROGEN FUEL TANK INERTING PROGRAM
Thomas G. Horeff *In its* 2d Conf. on Fuel System Fire Safety May 1970 p 193–203 (See N70-42753 24-03)
Avail: NTIS CSCL 13/12

The feasibility of a proposed nitrogen fuel tank inerting system for commercial aircraft was studied for installation in the FAA DC-9. The system replaces oxygen in the fuel tank vapor spaces and vent lines with nitrogen by discharges of liquid nitrogen into the main fuel tanks through fog nozzles maintaining a pressurization with nitrogen of 0.1 psig. Vent valves open at 0.2 psig to vent the gases overboard. The testing program is expected to generate data on nitrogen inerting systems which will be applicable to all turbine-powered aircraft. F.O.S.

N70-42820*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF TRANSFORMER OPERATING CONDITIONS ON THE WEIGHT OF A 375-KILOWATT-ELECTRIC RANKINE CYCLE SPACE POWER SYSTEM
Dale W. Cooper and John W. Stoll Washington Oct. 1970 12 p refs
(NASA-TM-X-2122; E-5815) Avail: NTIS CSCL 10B

An analytical study was performed to determine the optimum transformer operating temperature that results in minimum total system weight for a 375-kW sub e. Rankine cycle space power system. The load was considered to be a 375-kW sub e ion thruster, while the power source was a 2-MW sub t fast nuclear reactor driving a homopolar inductor alternator. A rectifier system was also employed, and various direct and refrigerated heat rejection systems were considered for both the transformer and rectifier. The results show that minimum system weight occurred at a 740 F (390 C) transformer operating temperature and that direct pumped fluid heat rejection gave the lowest weight. Author

N70-42951# Naval Ship Engineering Center, Washington, D.C. Propulsion Systems Analysis Branch.
THE 7TH ANNUAL TECHNICAL SYMPOSIUM: A CLOSED BRAYTON CYCLE POWER PLANT FOR UNDERWATER APPLICATIONS AND COMPARISON WITH A FUEL CELL
Harry Balukjian 1970 93 p refs
(AD-709387) Avail: NTIS CSCL 10/2

A 50 KW thermochemical power plant for underwater applications featuring a closed Brayton cycle power loop is described. A typical application to a deep operating submersible is examined and comparisons made with a fuel cell power source. Systems are studied for two depths (8,000 and 20,000 feet) and for three endurances (20, 40 and 120 hours). The analysis of a closed Brayton cycle includes a comparison using several different circulating gases in the loop such as Krypton, Argon and Xe - He. To make this analysis a computer program was developed in which values of enthalpy were obtained by multiplying the specific heat at constant pressure by temperature rather than using gas tables. Calculations are shown for a single fuel cell including the reversible emf and the ideal comparative thermal efficiency. Estimates are also given for the overall comparative efficiency of an actual fuel cell system. Pressure vessels needed to encapsulate the power conversion module and the two reactants account for approximately one half of the total system weight at neutral buoyancy. Calculations are shown for finding the specific fuel and oxidant consumption. This is needed to size the pressure vessels as well as to add to the weight and volume inventory. Author (TAB)

N70-42973# Franklin Inst., Philadelphia, Pa. Research Labs.
DESIGN AND DEVELOP SOLAR CELLS Final Report, 1 Apr. 1967–31 Mar. 1970
William H. Simpson and Philip J. Reucroft 11 May 1970 72 p refs
(Contract F19628-67-C-0273)
(AD-710081; FIRL-F-C2022; AFCRL-70-0264) Avail: NTIS CSCL 7/5

The photovoltages of solutions of chlorophyll and a donor or acceptor were measured for several systems. The effect of oxygen dissolved in the solvent was also investigated. The photovoltages were usually on the order of a few millivolts. In solid-lamellar systems consisting of chlorophyll and organic substrates the photovoltages were generally higher. An action spectrum indicated that the peak voltage occurred at the peak absorption in the red band. Photovoltage production in the solid systems was attributed to a bi-excitonic mechanism. Quantum mechanical tunneling and other conduction mechanisms were investigated in thin films of chlorophyll a. Author (TAB)

N70-43051*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
ANALYSIS AND EVALUATION OF SPACECRAFT BATTERY ACCELERATED LIFE TEST DATA
22 Sep. 1970 85 p
(NASA Order W12-397)
(NASA-CR-110862; QE/C-70-687) Avail: NTIS CSCL 10C

Findings are presented from the mathematical/statistical analysis of data generated from the accelerated life test on 40 nickel-cadmium spacecraft battery cells. Two major objectives of the analysis were to determine the applicability and reliability of the previously developed cell life prediction model when applied to an accelerated life situation, and to attempt to make alterations in the prediction model which would make it more conducive to accelerated life testing. Results of the analysis indicate about 75% accuracy in predicting the useful life of a cell with the original prediction model. The application of Bayesian analysis techniques yields the same accuracy, but enables the model to be formally used in the absence of historical data. Author

N70-43081*# Heliotek, Sylmar, Calif.
DEVELOPMENT OF AN INTEGRATED LIGHTWEIGHT FLEXIBLE SILICON SOLAR CELL ARRAY Final Report
E. L. Ralph, E. F. Zimmerman, and P. M. Stella [1970] 121 p Prepared for JPL
(Contract NAS7-100; JPL-952560)
(NASA-CR-110913) Avail: NTIS CSCL 10B

A comprehensive and complete description of the pertinent portions of this program in a self-contained format is presented. The objective of this program was to develop methods and analytical techniques which could be used to fabricate an integrated lightweight flexible silicon solar cell array blanket with the following capabilities: (1) providing 120 watts per pound of array weight, (2)

being manufactured at a cost of $100 per watt of raw power, and (3) being produced in modular prefabricated sections. The study effort was divided into seven major tasks in order to examine individual components comprising the total array concept. Author

N70-43130 National Lending Library for Science and Technology, Boston Spa (England).
SPECIFIC PROPERTIES OF SMALL SEALED LEAD ACID BATTERIES WITH FIXED ELECTROLYTE [SPEZIFISCHE EIGENSCHAFTEN VERSCHLOSSENER KLEINBLEIAKKUMULATOREN MIT FESTGELEGTEM ELEKTROLYTEN]
K. Eberts Dec. 1969 13 p refs Transl. into ENGLISH from Elektrotech. Z. (Berlin), v. 21, no. 13, 27 Jun. 1969 p 297–300
(NLL-SMRE-Trans-5771-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A description is given of a lead acid battery which requires no maintenance and is particularly suitable for portable appliance. It can be used in any position due to its construction in a plastic casing sealed by a valve, and to the effect of special glass fibre separators, combined with a thixotropic stabilised electrolyte. Self-discharge diagrams, the ratio of active mass to acid volume, and the degree of protection against complete discharge achieved, are explained. Power/weight and power/volume ratios are compared with those of comparable NiCd batteries. Author

N70-43156*# Gulf Radiation Technology, San Diego, Calif.
RADIATION EFFECTS IN SILICON SOLAR CELLS Quarterly Progress Report, 1 Jul.–30 Sep. 1970
R. A. Berger, J. F. Colwell, R. E. Leadon, J. A. Naber, and B. C. Passenheim 10 Oct. 1970 29 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952387)
(NASA-CR-110891; GA-10344) Avail: NTIS CSCL 10B

The nature of the defects responsible for the degradation in output of silicon devices (solar cells) irradiated by space radiation was studied for the following reasons: (1) to determine the parameters that will lead to development of radiation-hardened devices, (2) to predict the effects of radiation and annealing on solar cells, and (3) to make use of computer programs to predict radiation effects in solar cells on extended space flights. The effects of lithium on the production and annealing of damage in silicon are presented. This work is being performed on lithium-diffused bulk silicon using measurements such as minority-carrier lifetime, electron-spin resonance, electrical conductivity, and infrared absorption. The temperature range from 77.5 to 400 K is under investigation. The damage is introduced by 30-MeV electrons and fission neutrons. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N70-41888# Federal Aviation Administration, Washington, D.C. Communications Development Div.
TABLES OF RUNWAY VISUAL RANGE VALUES AS A FUNCTION OF TRANSMITTANCE AND VARIOUS VALUES OF PILOT'S ILLUMINANCE THRESHOLD AND LIGHT TARGETS Final Report
Alcott J. Larsson, John K. Marut, and Robert L. Northedge Aug. 1970 71 p
(FAA-RD-70-58) Avail: NTIS

Values of runway visual range (RVR) were developed for various atmospheric transmittances utilizing Allard's Law and Koschmieder's Law. Commonly employed constant's of pilot's contrast threshold and visual illuminance threshold are utilized in the appropriate RVR equations. Computations are based on a 250 foot baseline transmissometer with light target intensities of 10,000, 2,000 and 400 candela, values which are presently used in the United States. Information is presented in tabular form showing transmittances corresponding to runway visual range readings from 600 feet to 7000 feet in 50 foot increments. Each table includes data for each of the three light target intensities. A total of eight tables is provided. The computer program which was utilized to develop each set of data is included with each table. Author

N70-41891*# Techtran Corp., Glen Burnie, Md.
OCCURRENCE OF FILTERABLE MICROORGANISMS IN NATURE AND THEIR CULTURABILITY [UEBER DAS VORKOMMEN FILTRABLER MIKROORGANISMEN IN DER NATUR UND IHRE ZUECHTBARKEIT]
Gustav Seiffert Washington NASA Oct. 1970 10 p refs Transl. into ENGLISH from Zentr. Bakteriol. Parasitenk. (Germany), v. 7, no. 139, 10 Aug. 1937 p 337–342
(Contract NASw-2037)
(NASA-TT-F-13321) Avail: NTIS CSCL 06M

After enrichment of filtrates of various origins, it was possible to detect microscopically and culturally microorganisms which appear to be related to the pathogens of peripneumonia. They involve a special group of microorganisms which perhaps represent a transition to the typical virus forms. It was also possible to detect in nutrient liquids, biological reactions which indicate the presence and proliferation of an organism which is not visible and which otherwise cannot be cultivated. Author

N70-41936# RAND Corp., Santa Monica, Calif.
LEARNING-CURVE TABLES. VOLUME 3: 86-99 PERCENT SLOPES
H. E. Boren, Jr. and H. G. Campbell Apr. 1970 286 p
(Contract F44620-67-C-0045)
(AD-709178; RM-6191-PR-Vol-3) Avail: NTIS CSCL 14/1

The document contains volume 3 of three volumes of learning-curve data, including unit curve midpoints for plotting first-lot quantities. TAB

N70-41941# Illinois Univ., Champaign. Dept. of Psychology.
RELATIONS BETWEEN MULTIDIMENSIONAL SCALING AND THREE-MODE FACTOR ANALYSIS
Ledyard R. Tucker Jul. 1970 39 p refs
(Contract N00014-67-A-0305-003)
(AD-709575) Avail: NTIS CSCL 5/10

A combination is achieved of two lines of psychometric interest: multidimensional scaling and factor analysis. This is accomplished with the use of three-mode factor analysis of scalar product matrices, one for each subject. Two of the modes are the group of objects scaled and the third mode is the sample of subjects. Results are an object space, a person space and a system for changing weights given to dimensions and of angles between dimensions in the object space for individuals located at different places in the person space. The development is illustrated with data from an adjective similarity study. Author (TAB)

N70-41971# Florida State Univ., Tallahassee. Dept. of Psychology.
VISUAL EFFECTS OF IONIZING RADIATION
Kenneth L. Schafer (Ph.D. Thesis) [1969] 40 p refs
(TID-25431) Avail: NTIS

Data are reviewed from a number of studies on the effects of ionizing radiation on the visual systems of a number of species including insects, molluscs, and man. The data are compared in an effort to clarify the mechanisms of action of ionizing radiation and known functional aspects of the visual system. It was concluded that there is no good evidence to support the idea that ionizing radiation acts on the visual purple of the eye in a manner analogous

to light quanta. The studies of bleaching and energy absorption are simply not clear enough to indicate the nature of the interaction between ionizing radiation and the photopigment. In addition there is clear evidence from the studies of interactions between X-ray and light stimuli as backgrounds as well as stimulus pulses to indicate that the mechanisms for the detection of the two stimuli probably differ in basic ways at the receptor level. NSA

N70-42058# RAND Corp., Santa Monica, Calif.
UNIQUE MATHEMATICAL MODELS OF INDIVIDUAL BLOOD
E. C. De Land, E. Magnier, and J. V. Maloney, Jr. May 1970 106 p refs
(Contract F44620-67-C-0045; Grants PHS FR-3; PHS GM-13242; PHS G-5F3-HE-19; PHS-G-HE-08665-02 et al)
(AD-709183; RM-5396-PR) Avail: NTIS CSCL 6/16

A study was made of mathematical, computer-based methods of simulating the blood composition of individual clinical patients. Earlier studies developed procedures for constructing models of the respiratory function and acid-base biochemistry of statistically normal human blood. This memorandum extends these procedures and shows that, with sufficient laboratory data, such a model can be derived for individual patients, and conjectures that the blood's chemical pattern may indicate the patient's physical condition. Such models may be useful for clinical and experimental fluid therapy. Author (TAB)

N70-42079# National Academy of Sciences-National Research Council, Washington, D.C.
SPACE BIOLOGY
1970 61 p refs
Avail: Issuing Activity

A review is presented of a program dealing with space biology in a general biological context. While the study was primarily concerned with biological investigations in the space environment, it also considers the potential applications of earth-circling vehicles for measuring biological and ecological events in the earth's surface. Recommendations are made for medical and physiological investigations to be made in space and for earth-sensing uses of satellites for animal orientation and tracking. Other areas of interest include: biological rhythms; cells, plants, and invertebrates in space; and radiobiology. D.L.G.

N70-42090# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
ACTIVATION ENERGIES OF ACCELERATION AND HYPOXIA STRESS Phase Report
Freeman W. Cope 2 Jul. 1970 17 p refs
(AD-709569; NADC-MR-7015) Avail: NTIS CSCL 6/19

The activation energy of 13 kcal/M for loss of peripheral vision in man subjected to acceleration stress of 4% to 5% Gz resembles that of 12 kcal/M for survival of rats of 40% Gz, which suggests that the physiological mechanisms of acceleration protection are similar in the two species. The activation energy of survival to hypoxia stress (mouse) is 8.4 kcal/M which resembles the value of 8 kcal/M obtained for function of the normal human brain (alpha frequency of the eeg), which supports the concept that survival of the organism to hypoxia stress is indeed limited by survival of brain function. The large difference in activation energy of acceleration stress from that of hypoxia or of normal brain function suggests that tolerance to acceleration stress is not limited simply by the ability of nervous tissue to endure hypoxia, but must be dependent upon additional mechanisms. Author (TAB)

N70-42114*# Exotech, Inc., Washington, D.C.
PLANNING, EVALUATION, AND ANALYTICAL STUDIES IN PLANETARY QUARANTINE AND SPACECRAFT STERILIZATION Quarterly Progress Report, Period Ending 30 Sep. 1970
Sep. 1970 31 p refs
(Contract NASw-2062)
(NASA-CR-114166; QPR-2) Avail: NTIS CSCL 06M

The quarantine document system for planetary flight missions is reported in operation, with thesaurus expansion continuing. In the area of technology transfer planning, assistance was given for a briefing concerning the application of sterilization technology advances to Army field hospital operations in the 1980's. Work on the task of microbial release probability analysis focused on the quantification of fracture-related parameters of the release model. Three analytical models designed to facilitate flight project implementation of planetary quarantine requirements were developed or updated and exercised. These models include the thermal dynamics sterilization model, for which the computer program and flow chart is included; a water diffusion model of a spore; and a model relating the processes of microorganism growth and proliferation after release on a planet. Work concerning the feasibility of an organic constituent inventory for planetary flight missions is reported in terms of coordination with the Viking Project. P.A.B.

N70-42158*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
STUDIES OF THE PULMONARY CIRCULATION Annual Report
N. R. Kuchar 31 May 1970 86 p refs
(Contract NASw-1896)
(NASA-CR-114231) Avail: NTIS CSCL 06P

Using an approach based on the physical sciences, several aspects of blood flow through the pulmonary vascular bed are investigated. A model for the flow of red blood cells through narrow capillaries is formulated. The equations of fluid dynamics which pertain to the regions between adjacent cells (bolus region) and between a cell and the capillary wall (lubrication layer) are solved. Velocity and pressure distributions are presented for the physiological ranges of the physical parameters. Implications pertaining to pressure drop and mass transfer in capillaries are discussed. Based on the impedance concept for unsteady viscous flow in elastic tubes, a model which simulates the pressure-flow relationships for the pulmonary circulation in terms of the physical and environmental parameters is formulated and solved using an analog computer. Some preliminary simulations of interest for space physiology and medicine are presented. In vivo animal experiments, performed for model validation, are described. Author

N70-42169*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
QUALITY ASSURANCE REQUIREMENTS MANUAL FOR PLANETARY SPACECRAFT TO BE STERILIZED BY HEATING
Huntsville, Ala. NASA 30 Dec. 1968 246 p refs
(Contract NAS8-21139)
(NASA-CR-114264) Avail: NTIS CSCL 06M

Information and guidelines dealing with quality assurance requirements necessary for the production, assembly, and checkout of a spacecraft to be sterilized by heating in accordance with current NASA sterilization requirements are presented. The manual is intended for use as a supplement to a quality assurance manual for the class of spacecraft under consideration. Background data are included on planetary quarantine requirements and microbiology to provide quality assurance personnel with information on problems outside their area of specialization. Training programs, mathematical models, data bank requirements, inspection, fabrication and assembly, decontamination and terminal sterilization requirements, and detailed microbiological procedures are covered in the various sections. Author

N70-42178# Smithsonian Institution, Washington, D.C.
DISTRIBUTION OF PLANKTONIC FORAMINIFERA IN THE VICINITY OF THE NORTH ATLANTIC CURRENT

Richard Cifelli and Roberta K. Smith 1970 55 p refs *Its* Smithsonian Contrib. to Paleobiol. No. 4
(Contracts Nonr-2196(00); AT(30-1)-2174; Grant NSF GP-861)
Avail: SOD $0.65

Planktonic Foraminifera collected from the vicinity of the North Atlantic Current and the Gulf Stream during late winter-early spring and fall of 1964 are described and their distributions are recorded. Variations in faunal composition seem to be related largely to water regime dynamics and seasonal cycle. Among the fall collections, three distinctive assemblages can be recognized: a western group in the vicinity of the Gulf Stream, containing predominantly Sargasso Sea-Gulf Stream species dominated by Globigerinoides ruber; a northern group, dominated by Globigerina quinqueloba egelida, new subspecies, reflecting the influence of cold, northern waters adjacent to the North Atlantic Current; and an eastern group, dominated by Globigerina incompta, apparently developed within the limits of the North Atlantic Current. The last group seemingly represents an anomaly, as North Atlantic Current surface temperatures were relatively high at the time of collection, and dominance of a warm-water form, such as Globigerinoides ruber, was expected. The anomaly suggests that the North Atlantic Current is a partially closed gyre, fed by both slope waters and Gulf Stream. Temperatures are considered to be close to threshold for both cold and warm-water species. Author

N70-42185*# George Washington Univ., Washington, D.C. Biological Sciences Communication Project.
SCIENTIFIC PUBLICATIONS AND PRESENTATIONS RELATING TO PLANETARY QUARANTINE. VOLUME 5: THE 1969 SUPPLEMENT
Frank D. Bradley and Sandra G. Moritsugu Sep. 1970 106 p refs
(Contract NSR-09-010-027)
(NASA-CR-114112) Avail: NTIS CSCL 06T

This bibliography lists publications of the NASA Planetary Quarantine Program under funded contracts and grants issued during the calendar year of 1969. Author

N70-42225# California Univ., Los Angeles.
ELECTROMAGNETIC SEPARATION OF BIOLOGICAL PARTICLES Final Technical Report, 1 May 1960–31 Aug. 1969
Alexander Kolin 13 Aug. 1970 11 p refs
(Contract Nonr-233(64))
(AD-709986) Avail: NTIS CSCL 20/3

The project began with the general objective of utilizing electromagnetic forces in biological research methods. The phenomenon of electromagnetophoresis was discovered and explored. The possibility of stimulating irritable tissues without electrodes by alternating magnetic fields was demonstrated. The method of electromagnetic determination of blood flow was further developed and has become a standard method in biological and medical research, and in operating room blood flow measurements on human patients. The main investigations led to the conception of the method of isoelectric focusing which was demonstrated under ONR sponsorship and further developed in Sweden until it is now widely used in biochemical research as perhaps the most powerful method of protein analysis. Combination of electric and magnetic fields in a new configuration led to the development of the rotationally stabilized method of endless fluid belt electrophoresis which has high resolving power and is applicable to macromolecules as well as biological particles. This method is now being refined as it is put to use in measurements of electrokinetic properties of microorganisms. Author (TAB)

N70-42232*# Oak Ridge National Lab., Tenn.
CALCULATION OF THE RADIATION HAZARD AT SUPERSONIC AIRCRAFT ALTITUDES PRODUCED BY AN ENERGETIC SOLAR FLARE. 2
T. W. Armstrong and H. S. Moran 31 Dec. 1969 16 p refs Submitted for publication Sponsored in part by AEC
(NASA Order H-38280A)
(NASA-CR-110774; ORNL-TM-2844) Avail: NTIS CSCL 06R

Calculations were carried out to estimate the absorbed dose and dose-equivalent rates at various depths in the atmosphere produced by an energetic solar flare - the flare of February 23, 1956. The dose rates are determined both by computing flux spectra using air only and applying flux-to-dose conversion factors and by computing the dose rates in tissue using an air-tissue-air arrangement. The two methods of calculation are in reasonable agreement when the flux-to-dose factors are applied to the forward-flux spectra, but the calculations indicate that previous results obtained using omnidirectional-flux spectra overestimate the dose rates. Also, the effect of the fuel carried by a supersonic aircraft on the dose received by the passengers in the event of a solar flare has been considered and found not to be substantial. Author

N70-42250*# Michigan Univ., Ann Arbor. Human Performance Center.
RISKY DECISIONS BY INDIVIDUALS AND GROUPS
Barbara Cora Ettinger Goodman Jun. 1970 58 p refs
(Grant NGL-23-005-171)
(NASA-CR-114255; TR-21) Avail: NTIS CSCL 05J

Shifts were investigated between individual and group performance in two action selection tasks (a choice dilemma task in which subjects equate a risky option with a sure thing and a gambling task in which subjects wager their own money) and in one Bayesian diagnosis task (likelihood ratio estimation). Twenty-seven male subjects performed each task alone. Then 24 of these subjects were formed into 6 four-man leaderless groups and repeated each task. Three subjects, serving as individual controls, performed each task alone a second time. Finally, all 27 subjects repeated each task again alone. The group decisions in the choice dilemma task reproduced previously found patterns of shifts (compared with mean pregroup performance) toward the risky option or toward the sure thing. In the gambling task, groups tended to prefer higher variance gambles than did the average group member on his pregroup performance. In the likelihood ratio estimation task, 22 of the 24 test subjects estimates more closely resembled their group's values than their own pregroup estimates. Both group and individual correlations between measures of performance in all three tasks were low. Thus proclivity for a risky option in the choice dilemma, preference for higher variance in gambling, and tendency to extreme likelihood ratio estimates seem to be unrelated. Author

N70-42256*# Mayo Association, Rochester, Minn.
STUDIES OF THE EFFECTS OF GRAVITATIONAL AND INERTIAL FORCES ON CARDIOVASCULAR AND RESPIRATORY DYNAMICS Semiannual Status Report
Earl H. Wood 1 Apr. 1970 37 p refs
(Grant NGR-24-003-001)
(NASA-CR-110793) Avail: NTIS CSCL 06S

An assessment is given of the reproducibility and accuracy of the biplane roentgen videometry system developed for dynamic (60 per second) studies of the shape and volume of the left ventricle in intact animals or man. A study of the effects of a water immersion restraint system on distortion of the thorax and pulmonary arterial-venous shunts induced by transverse acceleration is discussed. Progress is reported on a study of the effects of breathing liquid fluorocarbon on regional differences in pleural pressures and other physiological parameters. Author

N70-42268*# Naval Medical Research Inst., Bethesda, Md.
PROJECT RIM: DESIGN AND IMPLEMENTATION
J. Michael Walsh, Ira Donenfeld, Seward Smith, William W. Haythorn, Philip L. Briley et al Apr. 1970 103 p refs

(NASA Order L-16423)
(NASA-CR-114259; AD-709075; REPT-2) Avail: NTIS CSCL 06P

In the fall of 1968, a comprehensive investigation into the psychological and physiological effects of long-term isolation and confinement began in the Behavioral Sciences Department of the Naval Medical Research Institute. The purpose of the paper is to provide comprehensive documentation of the research rationale and procedures for Project RIM. It is intended primarily as a reference document to answer broad as well as detailed questions that cannot be answered thoroughly in the limited space of a journal publication. No research data results are included.The various data areas of this small-group confinement study will be detailed in other papers as analyses are completed. Author (TAB)

N70-42272*# National Communicable Disease Center, Atlanta, Ga. Bacterial Diseases Branch.
REDUCTION OF MICROBIAL DISSEMINATION Progress Summary Report
Jul. 1969 9 p refs
(NASA Order W-13062)
(NASA-CR-114263; PSR-13) Avail: NTIS CSCL 06M

Studies related to the reduction of Clostridium perfringens dissemination from humans in support of planetary quarantine requirements are reported. The suitability of brain heart infusion agar and anaerobic agar as media for recovering and culturing viable airborne particulates of Cl. perfringens was investigated and the results compared with those of studies using reinforced clostridial agar. Initial results in detecting clostridial shedding from humans are described. N.E.N.

N70-42277*# Maryland Univ., College Park.
RELATIONSHIP BETWEEN SLOW DRIFT AND SMOOTH PURSUIT EYE MOVEMENTS
Robert Jesse Cunitz (Ph.D. Thesis) 1970 85 p refs
(Grant NSG-398)
(NASA-CR-114249) Avail: NTIS CSCL 06P

The relationship between noisy drift, corrective drift, and smooth pursuit eye movements was examined. The suggestion that smooth pursuit of a moving target is controlled by the same low velocity system that corrects position errors produced by noisy drifts during fixation of a stationary target was investigated by recording two-dimensional eye movements with a contact lens-optical lever while 2 experienced subjects fixated and subsequently tracked a point target suddenly set into motion in 8 unpredictable directions at 6 constant velocities. A correlational technique was used to determine the degree to which drifts corrected position errors during fixation of a stationary target. A vector averaging procedure was used to determine the direction and velocity of smooth pursuits. Author

N70-42284# Lovelace Foundation for Medical Education and Research, Albuquerque, N.Mex.
RADIATION EFFECTS ON AUDITORY AND VISUAL DISCRIMINATION TASKS IN MONKEYS Technical Progress Report
V. Bego, R. A. Hutton, and A. Bruner Mar. 1970 29 p refs
(Contract DA-49-146-XZ-359)
(AD-709971; DASA-2460) Avail: NTIS CSCL 6/18

Following shock-avoidance training on color and auditory discrimination problems, 12 rhesus monkeys were exposed to either 1500 or 6000 rads of pulsed, neutron-gamma radiation. Testing began one hour after irradiation. All monkeys exhibited performance decrement in the form of generalized incapacitation shortly before death, which occurred earlier for the 6000-rad animals. Prior to onset of the moribund state, however, no significant changes in performance were observed, although marked fluctuations in individual performances were evident. Of the response measures used, response latency underwent more change following irradiation than discrimination accuracy. Author (TAB)

N70-42285# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
SENSORY BEHAVIOR OF NAVAL PERSONNEL MONAURAL/BINAURAL MINIMUM AUDIBLE ANGLE OF AUDITORY RESPONSE Interim Report
J. Donald Harris and Russell L. Sergeant 14 Jun. 1970 24 p refs
(AD-709549; SMRL-607) Avail: NTIS CSCL 6/16

The paper considers what one ear contributes to man's perception of the auditory world and evaluates the monaural/binaural role in spatial orientation. Minimum audible angles were determined for monaural listening to moving sounds, and results were compared to similarly obtained binaural data. The findings are related to a review of facts and theories of sound localization by man. Author (TAB)

N70-42294# Naval Postgraduate School, Monterey, Calif.
THE COLLECTION AND ANALYSIS OF HUMAN FACTORS DATA IN TASK ANALYSIS
Rodney Paul Kempf (M.S. Thesis) Apr. 1970 53 p refs
(AD-709061) Avail: NTIS CSCL 5/5

The paper develops a questionnaire to be used in determining the necessity of various human factors to the successful performance of any particular job. Included in the proposed questionnaire are fifty-eight characteristics and a scheme for rating the variables. A program is developed for analyzing the data collected. A two-way analysis of variance by ranks is used to detect significant difference between the characteristics, and, given a difference exists, a method similar to the multiple range test is employed to separate the several characteristics into significance groups, the various groups being ranked on an ordinal scale. Author (TAB)

N70-42355# Federal Aviation Administration, Washington, D.C.
PHYSIOLOGICAL RESPONSES OF MEN DURING SLEEP DEPRIVATION
Vincent Fiorica, E. Arnold Higgins, M. T. Lategola, Audie W. Davis, Jr., and P. F. Iampietro May 1970 23 p refs
(FAA-AM-70-8) Avail: NTIS

The effects of 84 hours of sleep deprivation were examined in a group of six young men and compared with a group of six controls. Subjects were studied in pairs, one sleep-deprived and one control. Primary attention was given to the responses to acute whole body cold exposure in terms of internal body and skin temperature changes, oxygen consumption changes, and plasma catecholamine levels. Psychmotor performance was evaluated at 4-hour intervals over the course of the sleepless period and the patterns of urinary excretion of catecholamines, magnesium, and creatinine were followed. After the first sleepless night, psychomotor performance of sleep-deprived subjects was significantly lower than that of control subjects. The ability to regulate body temperature during standardized cold exposures, however, was not impaired by the loss of sleep. Urinary excretion patterns for the two groups were similar, except for differences related to activity level. Author

N70-42415# National Physical Lab., Teddington (England). Aerodynamics Div.
AN OUTLINE GUIDE TO CRITERIA FOR THE LIMITATION OF URBAN NOISE
D. W. Robinson London Aeron. Res. Council 1970 48 p refs Supersedes NPL-AERO-Ac-39; ARC-31161
(ARC-CP-1112; NPL-AERO-Ac-39; ARC-31161) Copyright. Avail: NTIS; HMSO: 12s; BIS: $2.40

A review is given of the steps involved in relating noise emitted in urban areas to the disturbance caused to the community, with special reference to transportation noise. An outline of existing methods of rating individual noises and of successions of noises is presented. From the latter a common measure, termed noise pollution level, emerges which is derived in a simple manner from

physical quantities and which summarizes the disturbing character of a complex noise environment. Suggestions for noise limits are included. Author (ESRO)

N70-42459# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
PROCEEDINGS OF THE SIXTH ANNUAL CONFERENCE ON MANUAL CONTROL
1970 913 p refs Held at Wright-Patterson AFB, Ohio, 7-9 Apr. 1970
(AD-709381) Avail: NTIS CSCL 1/3

The volume contains the proceedings of the following sessions: displays, neuro-muscular system analysis, man-machine analysis, manipulators and manipulation, advanced modeling techniques, describing function models, and describing function measurement techniques. Author (TAB)

N70-42461 National Lending Library for Science and Technology, Boston Spa (England).
THE AUTOMATIC MEASUREMENT OF PHOTOSYNTHETIC INTENSITY IN PLANTS BY MEANS OF APPARATUS IN WHICH THE CO2 CONCENTRATION IS CONTROLLED [AVTOMATICHESKOE IZMERENIE INTENSIVNOSTI FOTOSINTENZA RASTENII V USTANOVKAKH S REGULIRUEMOI KONSENTRATSIEI CO2]
V. I. Rozhdestvenskii Jun. 1970 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 6, 1968 p 865-875
(NLL-RTS-5810) Avail: Natl. Lending Library, Boston Spa, Engl.: 36s; 6 NLL photocopy coupons

The equipment used to measure the rate of photosynthesis in plants by means of apparatus in which the CO2 concentration is controlled is described. The equipment consists of serial units and enables the current values of photosynthetic rate to be registered on a self-recording tape at intervals of 2 to 10 minutes. The apparatus can function as a signal data unit proportional to the rate of photosynthesis in systems which automatically control the physiological processes. Author

N70-42561# Battelle Inst., Frankfurt am Main (West Germany).
BIOLOGICAL WASTE DISPOSAL AND ITS LIMITS
Wolfgang Schoenborn *In its* Battelle Inform. No. 5 Aug. 1969 p 30-35 (See N70-42557 24-34)
Avail: NTIS

The use of microorganisms for biological waste disposal is limited by general physical and chemical conditions, nutrient requirements, adaptation limits, metabiosis and polyauxie, toxins, etc. The great variety in type and quantity of waste products also causes problems for relevant technical processes. ESRO

N70-42568# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FOREARM POSITION CONTROL: PARAMETERS OF A MODEL WITH AGONIST-ANTAGONIST SWITCHING
William Watamaniuk (M.S. Thesis) Mar. 1970 101 p refs
(AD-710599; GE/BE/70-28) Avail: NTIS CSCL 6/2

The thesis describes an experimental study which validates and extends a proposed model of position control in the human forearm. Comparisons are drawn between best-fit theoretical curves, derived from the assumption of constant driving force, and actual distribution of phase trajectory data. At moderate to high velocities the data supports the assumption of constant driving force and optimal agonist-antagonist switching. Data of low variability is obtained t determine that the velocity feedback loop gain remains constant for all test conditions while the position feedback loop gain varies inversely with final position and directly with initial velocity signal. Author (TAB)

N70-42581# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
ANTHROPOMETRY OF THE AIR FORCE FEMALE HAND Final Report
John W. Garrett Mar. 1970 85 p refs
(AD-710202; AMRL-TR-69-16) Avail: NTIS CSCL 6/14

The report describes 56 anthropometric dimensions measured on the hands of Air Force female personnel (Women in the Air Force, Nurse Corp, and Biomedical Science Corps), aged 18-56. Summary statistics including the means, standard deviations, ranges, selected percentiles, measures of distribution, and coefficients of variation are presented for the 56 dimensions. Also included are statistical variations by age, rank and Corps within the sample, a complete correlation matrix, bivariate tables, and nomographs for various selected combinations of dimensions. TAB

N70-42595 National Lending Library for Science and Technology, Boston Spa (England).
THE OLDEST TRACES OF LIFE ON EARTH [DREVNEISHIE SLEDY ZHIZNI NA ZEMLE]
N. Krylov Jul. 1970 30 p refs Transl. into ENGLISH from Priroda (USSR), v. 11, 1968 p 41-54
(NLL-RTS-5829) Avail: Natl. Lending Library, Boston Spa, Engl.: 58s; 10 NLL photocopy coupons

A review of the geological findings of Precambrian life is presented. Pre-algae microorganisms, blue green algae, and the earliest fauna are described. Illustrations of the fossils are included. N.E.N.

N70-42625# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
ANTHROPOMETRY OF THE HANDS OF MALE AIR FORCE FLIGHT PERSONNEL Final Report
John W. Garrett Mar. 1970 80 p refs
(AD-709883; AMRL-TR-69-42) Avail: NTIS CSCL 6/14

This report contains descriptions of and data on 56 anthropometric dimensions of the hands of 148 male Air Force flight personnel. Selected dimensional comparisons indicate that this sample is representative of the total group of Air Force flight personnel. Summary statistics presented include the means, standard deviations, ranges, selected percentiles, and coefficients of variation. Also included are data on the age, rank, major Air Command, and commissioned status of the sample; a complete matrix of intercorrelations among the anthropometric dimensions; bivariate tables; multiple regression equations; and nomographs for selected combinations of dimensions. A procurement table for the U.S. Air Force 12-size glove program revised to reflect the latest anthropometric data is presented. Author (TAB)

N70-42650# Pennsylvania Univ., Philadelphia. School of Medicine.
HISTOPATHOLOGY OF ARGON LASER-INDUCED RETINAL LESIONS Annual Progress Report, 1 Aug. 1969 - 31 Jul. 1970
Myron Yanoff Aug. 1970 10 p refs
(Contract DADA17-70-C-0011)
(AD-710406; APR-1) Avail: NTIS CSCL 6/5

The purpose of this project was to obtain information on the biologic effects of the argon laser on the retina. After owl and rhesus monkeys were exposed to a continuous wave argon laser the eyes were evaluated. Serial sections were cut with a microtome through the suspicious retinal areas in order to determine the presence or absence of retinal damage. Both methods--the serial sections of the suspicious retinal lesions and the flat-mount retinal pigment epithelial preparations--gave very satisfactory information on threshold argon laser retinal lesions. The flat-mount preparations, however, proved to be the quickest and most useful method. Both methods enabled us to show that the histopathology correlated excellently with the clinically seen retinal lesions. The flat-mount preparations proved to be slightly more sensitive than

ophthalmoscopic observations in identifying threshold retinal lesions. The pigment epithelium was the most sensitive area of the retina exposed to threshold argon laser energies. The photoreceptor and outer nuclear layers were the next most sensitive retinal areas. The inner layers of the retina seemed to be relatively unaffected by the argon laser at threshold energies. Author (TAB)

N70-42652# Honeywell, Inc., St. Paul, Minn. Research Dept.
A TIME COURSE EVALUATION OF THE EYE'S ACCOMMODATIVE RESPONSE Final Report, 1 May 1969 - 28 Feb. 1970
Clinton L. Jolliffe Jun. 1970 78 p refs
(Contract DADA17-69-C-9130)
(AD-710394; Rept-12159-FR) Avail: NTIS CSCL 6/16

Accommodative response durations of the eye were measured by an objective and subjective technique. Results of the study demonstrate that a relationship exists between the accommodative response duration and spectral composition of the target and subject age. Target luminance levels that differed by no more than three orders of magnitude were tested for effect on the accommodative response duration. Author (TAB)

N70-42662# Battelle Inst., Frankfurt am Main (West Germany).
CELL BIOLOGY RESEARCH GROUP AT BATTELLE
In its Battelle Inform. No. 4 Apr. 1969 p 22-23 (See N70-42660 24-34)
Avail: NTIS

The development of the new discipline of cytochemistry is described. Microphotometry and microfluorometry, microspectrophotometry and interference, polarising and electron microscopy quantitative methods for cell structure investigations are described. ESRO

N70-42664*# Techtran Corp., Glen Burnie, Md.
CHANGES OF MINERAL METABOLISM DURING HYPOKINETIC CONDITIONS [IZMENENIYE VODNO-SOLEVOGO OBMENA PRI GRANICHENII DVIGATEL'NOY AKTIVNOSTI]
V. P. Krotov Washington NASA Oct. 1970 13 p refs Transl. into ENGLISH from 21st Intern. Astronautical Congr. (Constance, Moscow), 4-10 Oct. 1970 13 p
(Contract NASw-2037)
(NASA-TT-F-13375) Avail: NTIS CSCL 06S

The effect of prolonged restriction of motor activity on the mode of changes in mineral metabolism of rabbits is examined. During the first day of the exposure to hypokinesis the plasma liquefied, and the hematocrit number and hemoglobin concentration in the blood tended to decrease. The plasma volume calculated according to the method of Strauss increased by 5.1%. During the subsequent three hypokinetic weeks a redistribution of water between the plasma and erythrocytes took place. The potassium and sodium concentration in the plasma decreased as the exposure continued. The potassium and sodium content in various myocardial compartments of test rabbits changed differently. Judging by mineral metabolism parameters, no distinct signs of adaptation of the animal organism to prolonged hypokinesia were observed. Author

N70-42727*# Sandia Corp., Albuquerque, N.Mex. Planetary Quarantine.
A STOCHASTIC APPROACH TO BIOBURDEN ESTIMATION AND PREDICTION: A PRELIMINARY REPORT
A. L. Roark Aug. 1970 63 p refs
(NASA Order W-12853)
(NASA-CR-110902; SC-RR-70-561) Avail: NTIS CSCL 06M

An approach to modeling bioburdens that has many of the properties generally recognized as desirable for such models is described. A probability distribution for the bioburden on a surface, at any time t, is derived in closed form. This distribution depends upon the way in which organisms are clumped and the deposition rate and removal percent of these clumps. Examples are given of how this model may be used to estimate and predict bioburdens and specify confidence limits about these estimates and predictions. An indication is also given of how the model may be used to establish sampling protocols. Author

N70-42740*# Translation Consultants, Ltd., Arlington, Va.
STUDY OF REACTIVITY TO TRANSVERSE ACCELERATIONS AND RADIOPROTECTANTS [ISSLEDOVANIYE REAKTIVNOSTI ORGANIZMA V USLOVIYAKH DEYSTVIYA POPERECHNO NAPRAVLENNYKH PEREGRUZOK I PROTIVOLUCHEVYKH FARMAKOKHIMICHESKIKH SREDSTV]
V. V. Antipov et al Washington NASA Oct. 1970 12 p refs Transl. into ENGLISH from Russian Report Presented at the 21st Intern. Astronautical Congr., Constance, West Ger., 4-10 Oct. 1970
(Contract NASw-2038)
(NASA-TT-F-13370) Avail: NTIS CSCL 06S

The results of studies on the effect of radioprotectants on the animal tolerance to back-to-chest accelerations and sensitivity to the preparations under space environment simulation are presented. Author

N70-42741# Utrecht State Univ. (Netherlands). Physics Lab.
THE EFFECT OF GAMMA-RADIATION IN COLLAGEN SOLUTIONS. A PHYSICO-CHEMICAL STUDY
Johannes Jacobus Maria Labout (Ph.D. Thesis) Jan. 1970 81 p refs Sponsored in part by Neth. Ogan. for Pure Sci. Res. and Neth. Found. for Chem. Res.
Avail: NTIS

The behavior of collagen solutions under gamma irradiation was studied and the often drastic changes in the sizes and shapes of the molecules were investigated using light scattering, viscometry, and electron microscopy. ESRO

N70-42773*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROBABILITY LEARNING: THE SHORTEST PATH HYPOTHESIS
Edward M. Huff Sep. 1970 8 p refs
(NASA-TM-X-62005) Avail: NTIS CSCL 05J

A specific hypothesis was tested concerning the development of a preference effect in human decision tasks that require predictions of future events. Six groups of subjects were exposed to different probabilistic sequences in which the recurrence paths to the preceding event varied in length. It was hypothesized that subjects would develop a preference for alternatives with the shortest recurrence paths. The results clearly support the hypothesis and show how the characteristics of the probabilistic environment influence human task performance. Author

N70-42779# Congress. House. Committee on Government Operations.
THE ENVIRONMENTAL DECADE (ACTION PROPOSALS FOR THE 1970's) From the Conservation and Natural Resources Subcommittee
Washington GPO 1970 367 p refs Hearings before Comm. on Govt. Operations, 91st Congr., 2d Sess., 2-6 Feb., 13 Mar., and 3 Apr. 1970
Avail: SOD $1.25

Congressional testimony is reported on proposals for the 'Environmental Decade' of the 1970's. The proposals include adequate funding for waste treatment plants, separation of storm and sanitary sewers, development of desalinization and recycling and the prevention of waste by evaporation and other causes, elimination of sources of pollution, preservation of wetlands and estuaries.

development of pollution-free automotive engines as alternatives to present internal combustion engines, standards for industrial and power plants in elimination of polluting discharges, elimination of agricultural soil erosion and siltation from highway construction and suburban development, control of chemical pollution from the use of fertilizers, herbicides, and persistent pesticides, standards for regional and national planning, strict controls for solid waste disposal, preservation of wildlife habitats and marine resources, and provisions for better management of mineral and forest resources. R.B.

N70-42780 National Lending Library for Science and Technology, Boston Spa (England).

IMPROVEMENT OF INDICES OF THE BLOOD COAGULATORY SYSTEM OF HAEMOPHILIA PATIENTS FOLLOWING PHYSICAL EXERCISES [OB ULUSHCHENII POKAZATELEI SVERTIVAYUSCHCHEI SISTEMY KROVI U BOLNYKH GEMOFILIEI PRI FIZICHESKIKH UPRAZHENIYAKH]

I. S. Damsker et al Jul. 1970 8 p refs Transl. into ENGLISH from Probl. Gematol. i Pereliv. Krovi (Moscow), v. 14, no. 3, 1969 p 24–26

(NLL-RTS-5902) Avail: Natl. Lending Library, Boston Spa, Engl.: 14s: 2 NLL photocopy coupons

The effects of various physical stresses on the course of hemophilia and the change in the activity of the blood coagulation factors in hemophilic patients were investigated. The group of subjects consisted of 30 cases of hemophilia with blood effusions and lesions of joints. The study included the possibility of physical exercises in cases of hemophilia with frequent relapses of the disease, the possibility of physical exercises leading to a deterioration of the morbid conditions, and an exercise program suitable for hemophilic patients with hemorrhagic effusions into joints. R.B.

N70-42804# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

ELECTROCARDIOGRAM RECORDING WITH PASTELESS ELECTRODES

George E. Bergey, Russell D. Squires, and William C. Sipple 30 Jun. 1970 24 p refs

(AD-709919; NADC-MR-7014) Avail: NTIS CSCL 9/1

Experimentation regarding various aspects of a technique for recording electrocardiographic potentials from unprepared skin, without the use of conventional paste, is described. Because of the relatively high skin-to-electrode impedances encountered without electrolytic paste, high input impedance amplifiers must be utilized for acquisition of the signal. In order to minimize susceptibility to external electrostatic and electromagnetic interference, an inherent problem with high input impedance amplifiers, buffer amplifiers were incorporated directly within the electrode housing. Of the different metals tested, stainless steel proved to be the most stable skin contact material for pasteless operation. The integrated electrode/buffer amplifiers described comply with specifications of the American Heart Association and should prove useful as a direct replacement for conventional paste-type electrodes in existing clinical ECG equipment as well as for long-term applications, such as space missions and intensive care unit patient monitoring, where frequent attention to the electrodes is inconvenient. Author (TAB)

N70-42816# Tulane Univ., New Orleans, La.

DELTA REGIONAL PRIMATE RESEARCH CENTER. LONG TERM EFFECTS OF PRENATAL X-IRRADIATION AND GAMMA-IRRADIATION ON CEREBRAL CORTEX Technical Progress Report, 1 Jun. 1969–31 May 1970

Kenneth R. Brizzee May 1970 21 p refs

(Contract AT(40-1)-3832)

(ORO-3832-8) Avail: NTIS

The effects of exposure of prenatal or neonatal rats to various doses of single, fractionated dose, or continuous whole-body gamma or X-radiation on the development of the cerebral cortex were investigated. The kinetics of brain cell development in nonirradiated and 100 R gamma-irradiated rats were studied in timed pregnancy rats injected with H-3-thymidine on the 13th gestation day followed by counts of labeled metaphase nuclei in cells of the primordial ependymal layer. Histological examination of brain tissues showed that residual radiation damage in cerebral hemispheres increased slowly between doses of 25 R and 75 R, but increased rapidly following exposure to higher doses. The brains of animals exposed to fractionated doses of 100 R plus 50 R and 100 R plus 100 R gamma radiation showed much less residual damage than animals subjected to the same total dose administered by a single exposure. Hypothermia induced at various times during the irradiation schedule caused changes in the radiation response. NSA

N70-42825*# Martin Marietta Corp., Denver, Colo.

A STUDY PROGRAM ON THE DEVELOPMENT OF A MATHEMATICAL MODEL(S) FOR MICROBIAL BURDEN PREDICTION. VOLUME 10: PHASE 9 WITH REVISIONS TO VOLUME 6 USER'S MANUAL, ADDENDUM

Lloyd B. Farabee Sep. 1970 90 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952532)

(NASA-CR-110892; MCR-68-97) Avail: NTIS CSCL 06M

The histogram method for combining random variables was refined in order to obtain more realistic predictions of the microbial burden on spacecraft. The bases of histogram operations (adding, multiplying, dividing, subtracting, determining the maximum) are described to show the nature of the problems involved and the reasons for inaccuracies. A recommended technique is outlined and a listing of the revised computer program to incorporate the technique into the previously developed Microbial Burden Prediction model is included. Sample calculations are included to illustrate the operations discussed. Author

N70-42848# Albert Einstein Medical Center, Philadelphia, Pa. Dept. of Genetics.

ULTRAVIOLET LIGHT EFFECTS ON NUCLEIC ACID FORMATION AND GENETIC EVENTS IN BACTERIA Annual Progress Report

C. O. Doudney Apr. 1970 6 p refs

(Contract AT(30-1)-3893)

(NYO-3893-16) Avail: NTIS

Studies were conducted on photoreversibility of UV-induced mutations and lethality in Escherichia coli. It was found that loss of photoreversibility with postirradiation incubation of UV-induced mutations for streptomycin resistance and lethal damage occurred during the first 20 min of incubation and was unaffected by the absence of tryptophan with an amino acid-requiring substrain or by the absence of thymine with a thymine-requiring substrain but was blocked by dinitrophenol. Loss of photoreversibility of UV-induced lethality and damage to DNA replication were studied. Effects of acriflavine on mutation frequency following ultraviolet radiation were investigated. The rates of DNA replication relative to unirradiated controls were calculated for various doses of UV in amino acid-starved bacteria. Studies on photoreversibility of dark repair blockage of DNA synthesis showed that with low doses of UV this inhibition was eliminated by photoreversal treatment. NSA

N70-42849# Albert Einstein Medical Center, Philadelphia, Pa. Dept. of Genetics.

ULTRAVIOLET LIGHT EFFECTS ON NUCLEIC ACID FORMATION AND GENETIC EVENTS IN BACTERIA, THREE YEAR COMPREHENSIVE REPORT

C. O. Doudney Apr. 1970 48 p refs

(Contract AT(30-1)-3893)

(NYO-3893-15) Avail: NTIS

When Escherichia coli H/r cells were exposed to 400 ergs/sq mm of ultraviolet light and incubated without arginine, degradation

of RNA and of ribosomes occurred. Under these conditions the ribosomes remained stable for one hour but rapid breakdown of the ribosomes occurred within two hours. The presence of arginine in the medium prevented most of the breakdown. Most of the damage was not photoreversible. Studies on the effects of acriflavine on uv-damaged bacterial cells were conducted. Results showed that concentrations of acriflavine that do not interfere with RNA synthesis in nonirradiated bacteria decrease the formation of RNA in uv-damaged bacteria. This phenomenon was used to study the recovery of normal capacity to form RNA in acriflavine by bacteria damaged by uv light. Experiments showed that photoreversible pyrimidine dimers in DNA were responsible for post-radiation effects of the dye on RNA formation. NSA

N70-42851*# Scripta Technica, Inc., Washington, D.C.
PROBLEMS OF SPACE BIOLOGY. VOLUME 13: PROLONGED LIMITATION OF MOBILITY AND ITS INFLUENCE ON THE HUMAN ORGANISM
A. M. Genin, ed. et al NASA Oct. 1970 271 p refs Transl. into ENGLISH of the book "Problemy Kosmicheskoy Biologii, Tom 13. Dlitel'noye Ogranicheniye Podvizhnosti i Yego Vliyaniye Na Organism Cheloveka" Moscow, Nauka, 1969
(Contract NASw-2036)
(NASA-TT-F-639) Avail: NTIS CSCL 06S

Papers are presented from a complex clinical-physiology study of healthy subjects who were confined to bed for long periods. The following are described in broad terms: effects of prolonged mobility restriction on functional systems, tolerance to orthostatic tests and load factors, efficacy of physical exercises and other prophylaxis in preventing unfavorable shifts in the organism during prolonged confinement to bed. For individual titles see N70-42852 to N70-42883.

N70-42852*# Scripta Technica, Inc., Washington, D.C.
PROLONGED LIMITATION OF MOBILITY AS A MODEL OF THE INFLUENCE OF WEIGHTLESSNESS ON THE HUMAN ORGANISM
A. M. Genin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 1–7 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Experimental approaches to evaluation of the biological effects of prolonged weightlessness are examined. Laboratory simulation of weightlessness, with prolonged bed rest as an example, is defended. The initial conception that formed the basis for the 70-day hypodynamia study is formulated. Author

N70-42853*# Scripta Technica, Inc., Washington, D.C.
ORGANIZATIONAL AND METHODOLOGICAL PRINCIPLES FOR THE CONDUCT OF PROLONGED HYPODYNAMIA RESEARCHES
P. A. Sorokin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 8–14 (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The influence of prolonged hypodynamia on the human organism was investigated under clinical conditions in five series of experiments in which 16 subjects spent 70 days confined to bed. Series 1 was the control (pure hypodynamia), consisting of 4 subjects. Series 2 through 5 imposed hypodynamia together with various combinations of prophylactic measures on 12 subjects. The most general methodological approaches to study of the effects of hypodynamia and evaluation of the effectiveness of various prophylactic measures are characterized. Author

N70-42854*# Scripta Technica, Inc., Washington, D.C.
CLINICAL OBSERVATIONS IN PROLONGED HYPODYNAMIA
P. A. Sorokin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 15–25 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The results of clinical observations on the state of 16 subjects over 70 days of bed rest are reported. The psychological effects of prolonged hypodynamia are analyzed and data on the pathology of the subjects during the experiments are presented. Author

N70-42855*# Scripta Technica, Inc., Washington, D.C.
CHANGES IN ELECTROCARDIOGRAM AND STATISTICAL STRUCTURE OF CARDIAC RHYTHM IN THE COURSE OF CONFINEMENT TO BED
A. D. Voskresenskiy et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 26–33 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Analysis of EKG recorded during a 70-day confinement to bed showed position changes, relative inhibition of conduction, decreased amplitude of the R and T deflections, a change in the relationship between the T from various leads, a periodic displacement of the S-T segment, and changes in the repolarization process for all of the subjects. These shifts appeared later and were less consistent in subjects who performed a set of physical exercises. Correlation functions calculated for series of 200 to 300 successive values of the R-R interval revealed a picture of respiratory-arrhythmia decay and the appearance of undulating variations of the rhythm that were not related to respiration. The R-R correlation functions showed little change from their original form in the individuals who performed physical exercises. Author

N70-42856*# Scripta Technica, Inc., Washington, D.C.
HEMODYNAMIC CHANGES DURING PROLONGED HYPOKINESIA ACCORDING TO MECHANOCARDIOGRAPHIC DATA
V. V. Simonenko *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 34–42 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

A dominant influence of the sympathetic innervation on the cardiovascular system is observed during prolonged hypokinesia. Prolonged hypokinesia changes the reaction of man to cold, as manifest in the phasing of the reactions, lower strength of the response reaction, and lowering of the tonicity coefficient of the blood vessels. The cuff test can serve as a tentative indicator of the ability of the cardiovascular system to react during hypokinesia to compensate exclusion of a certain amount of blood from circulation. Physical conditioning mitigates the deconditioning effect of hypokinesia on the cardiovascular system to some degree, but does not eliminate it completely. Author

N70-42857*# Scripta Technica, Inc., Washington, D.C.
HEMODYNAMIC CHANGES DURING PROLONGED HYPOKINESIA ON THE BASIS OF THE DYE-DILUTION METHOD
A. P. Pekshev *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 43–51 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Under the conditions of strict confinement to bed, the hemodynamic changes in the subjects usually increase with increasing time of hypodynamia. In a number of cases, however, stabilization of certain blood-circulation indices is observed, or they return to their original values in the course of the experiments; this makes it possible to speak of a certain adaptability of the cardiovascular system to the abnormal conditions of hypodynamia. Individual peculiarities make their appearance here in the hemodynamics of the subjects. Under the conditions of hypodynamia without prophylactic measures, there is a distinct decrease in stroke volume, minute heart volume, and the mass of central (intrathoracic) blood, a slight decrease in circulating plasma, an increase in the hematocrit, and an increase in the time of a complete blood-circulation cycle. If measures are taken during hypodynamia to prevent circulatory disorders (pharmaceuticals, physical exercises), there are some changes in the directions taken by the hemodynamic shifts. Here,

the nature of the hemodynamic changes observed in some subjects suggests mitigation of the circulatory disturbances that arise during prolonged hypodynamia. Author

N70-42858*# Scripta Technica, Inc., Washington, D.C.
PHASE CHANGES IN THE CARDIAC CYCLE DURING PROLONGED HYPODYNAMIA ACCORDING TO POLYCARDIOGRAPHIC AND KINETOCARDIOGRAPHIC DATA
M. I. Tishchenko et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 52–57 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Phase analysis of cardiac activity under the conditions of prolonged hypodynamia brings out changes in the phase structure of the cardiac cycle that are manifested in the development of a hypodynamic phase syndrome. This takes the form of shortening of the blood-expulsion and mechanical-systole phase, lengthening of the tension, isometric-contraction, and myocardial-relaxation phases and a decrease in the initial rise rate of intraventricular pressure. By the fourth week after hypodynamia, normal phase activity has been restored in the cardiac cycle. The hypodynamic phase syndrome is equally in evidence among subjects of the control group and those of the group in which prophylactic measures were taken. Author

N70-42859*# Scripta Technica, Inc., Washington, D.C.
INFLUENCE OF PROLONGED HYPODYNAMIA ON HEART SIZE AND THE FUNCTIONAL STATE OF THE MYOCARDIUM
I. G. Krasnykh *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 58–65 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The thoracic organs of individuals subject to prolonged hypodynamia (70 to 73 days) were studied roentgenologically. It was established as a result of the study that prolonged hypodynamia leads to substantial hemodynamic abnormalities, with the result that heart size decreases by 12.9 to 17.9%. When complex medication was given by way of prophylaxis, the area changes were half those in the control in two subjects and the same as in the control in one subject. The contractile function of the myocardium changed in all subjects. Physical exercises combined with medication resulted in less significant changes in both heart size and heart contractile function. The extent of heart-area decrease when a set of prophylactic measures was taken (physical exercises, femoral cuffs, and complex medication) was the same as in the control group in 5 of 6 subjects, and even greater in certain individuals. The observed changes in the heart were functional in nature, and returned to normal after the subjects resumed their normal everyday activities. Author

N70-42860*# Scripta Technica, Inc., Washington, D.C.
CERTAIN PECULIARITIES OF EXTERNAL RESPIRATION AND GAS EXCHANGE DURING PROLONGED HYPODYNAMIA
M. I. Mikhasev et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 66–72 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The effects were studied of 70-day hypodynamia on the basal metabolic level, the spirographic and pneumotachymetric indicators of external respiration, oxygenation of arterial blood, bloodstream velocity, and gas exchange under standard physical load and in orthostatic tests. Basal metabolism was lowered by 5 to 21%, pulmonary ventilation volume was reduced, oxygen demand in the orthostatic tests was increased, and there was a substantial decrease in the tolerance of physical load. The disturbances noted were mitigated by the use of preventive measures: medication and physical exercise. Author

N70-42861*# Scripta Technica, Inc., Washington, D.C.
NUTRITION AND METABOLISM DURING PROLONGED HYPODYNAMIA
M. S. Seregin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 73–88 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Examination of subjects who spent 70 days in hypodynamia indicated a decreased energy requirement coupled with a decrease in body weight. The level of protein metabolism was depressed. A negative nitrogen balance was established. The protein loss averaged 8 g/day. Calcium excretion was up 40%. The excretion of vitamins C1, B1, B2, and PP with the urine decreased. The blood concentration of corticosteroids had fallen, and smaller amounts were excreted with the urine. The orthostatic test was accompanied by considerable enhancement of hypophyseal-adrenal function. Neither physical exercises nor medications prevented the metabolic disturbances. Author

N70-42862*# Scripta Technica, Inc., Washington, D.C.
MINERAL SATURATION OF BONE TISSUE UNDER CONDITIONS OF PROLONGED HYPODYNAMIA
I. G. Krasnykh *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 89–95 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The mineral-saturation level of the right calcaneus and the first phalanx of the fifth finger of the right hand was studied by X-ray photometry in individuals subjected to prolonged hypodynamia. It was established that 70 to 73 days of hypodynamia reduced the amount of calcium salts in the calcaneus by an average of 11.8% and in the first phalanx of the fifth finger by 6.9%. Recovery of the calcium salts to the initial level was not complete a month later. Use of complex preventive medication did not favorably influence the level of decalcification by comparison with a control. Physical exercises prescribed for prophylactic purposes and a combination of exercise with inflatable femoral cuffs and medications resulted in smaller (by factors of 2 to 5) losses of phosphorus and calcium salts by comparison with the control. Author

N70-42863*# Scripta Technica, Inc., Washington, D.C.
INVESTIGATION OF CERTAIN BIOCHEMICAL BLOOD SERUM INDICATORS DURING PROLONGED HYPODYNAMIA
I. I. Ivanov et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 96–105 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

A trend to lower blood-serum potassium contents was noted toward the end of an extended period of hypodynamia. A rise in the activity of alkaline phosphatases in the blood serum is reported. The activities of aspartate-aminotransferase, alanine-aminotransferase, aldolase, and creatinekinase, and the contents of sodium, phosphorus, calcium, microelements, and urea in the blood serum of the individuals studied showed no change. Author

N70-42864*# Scripta Technica, Inc., Washington, D.C.
UREA CONTENT IN THE BLOOD DURING PROLONGED LIMITATION OF MOBILITY
T. A. Orlova *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 106–107 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Blood urea content was studied in 19 subjects of a 70-day hypodynamia experiment to determine whether increases previously observed in 15- and 30-day experiments normalize over longer periods of restricted mobility. The results indicate that the effect is nonpathological, that normalization does occur, and that the most probable cause of high blood urea is renal insufficiency rather than increased nitrogen intake or tissue protein breakdown. Author

N70-42865*# Scripta Technica, Inc., Washington, D.C.
COAGULABILITY OF BLOOD DURING PROLONGED HYPODYNAMIA ACCORDING TO THROMBO-ELASTOGRAPHIC DATA
Ye. I. Dorokhova *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 108–112 ref (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Prolonged hypodynamia was accompanied by the appearance of a general hemophilic reaction of the blood. The partial blood coagulation reactions varied in the opposite direction. Physical exercises reduced the hemophilic shifts. Combining physical exercises on a treadmill or bicycle ergometer with occlusion conditioning slightly reduced the antihemophilic effect of the physical exercises.
Author

N70-42866*# Scripta Technica, Inc., Washington, D.C.
RESISTANCE TO INFECTION UNDER CONDITIONS OF HYPODYNAMIA
B. A. Chukhlovin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 113–120 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Changes in both the nonspecific resistance of the organism to infection and specific immunological reactivity took place under conditions of prolonged hypodynamia. These changes may tend to increase the activity of conditionally pathogenic and saprophytic automicroflora vegetating in the organism, and may also contribute to activation of latent infections or the propagation of an agent introduced from the outside.
Author

N70-42867*# Scripta Technica, Inc., Washington, D.C.
FUNCTIONAL STATE OF THE CENTRAL NERVOUS SYSTEM DURING PROLONGED HYPODYNAMIA
G. D. Yefimenko *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 121–132 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Rheoencephalography brought out consistently directed shifts in the hemodynamics of the brain in all subjects: a decrease in the blood-filling index and vascular tone index, shorter propagation times of the rheographic wave, and increased lability of the hemoregulatory nerve centers. Signs of the functional disturbances to the central nervous system that are characteristic of neurotic states were observed on the survey electroencephalograms of all subjects. There was apparently no decrease in the short-term fitness of the subjects for light mechanized labor during the 75 days of hypodynamia. Analysis of the indicators for each individual subject indicates phasing of the changes during the prolonged hypodynamia.
Author

N70-42868*# Scripta Technica, Inc., Washington, D.C.
CHANGES IN THE FUNCTIONS OF THE NERVOUS AND MUSCULAR SYSTEMS UNDER THE INFLUENCE OF PROLONGED HYPODYNAMIA
A. G. Panov et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 133–147 (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Definite staging of the changes was discerned. The initial stage was characterized by early adaptive reactions, and the intermediate stage by atrophy of muscles, especially those of the lower legs. The advent of the third stage (after 20 days of hypodynamia) was marked by disturbances to higher nervous activity: disturbed sleep, emotional disturbances, and other asthenic symptoms. With the asthenic state as a background, oral-automatism phenomena and signs of pyramidal insufficiency appeared among the subjects. The latter were manifested in increased tendon and periosteal reflexes in the right extremities, loss of strength in these extremities, decrease or loss of the abdominal and plantar reflexes on the right side, smoothing of the right nasolabial fold, and deviation of the tongue to the right. The development of interhemispheric asymmetry with hypodynamia and functional insufficiency of the dominant hemisphere was noted in 14 out of 16 subjects. A gradual recovery of nervous system functions was observed after reactivation.
Author

N70-42869*# Scripta Technica, Inc., Washington, D.C.
CHANGES IN CERTAIN HUMAN MOTOR FUNCTIONS AFTER PROLONGED HYPODYNAMIA
V. S. Gurfinkel et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 148–159 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The influence of prolonged hypodynamia on the retention of such motor functions as maintaining vertical position, walking, and rising from the supine position, and the innervation relationships (crossover effects in the spinal cord, vestibulospinal effects) on which these functions are based were investigated and the various ways of preventing hypokinetic disturbances were evaluated. The motor functions studied were selected because they are primarily automatic and independent of voluntary intervention under ordinary conditions. The physical conditioning methods used in the experiments were effective in preventing gross motor disturbances.
R.B.

N70-42870*# Scripta Technica, Inc., Washington, D.C.
CHANGES IN THE BIOCHEMICAL PECULIARITIES OF WALKING UNDER THE INFLUENCE OF HYPODYNAMIA ACCORDING TO ICHNOGRAPHIC DATA
V. G. Skrypnik *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 160–169 ref (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The locomotor act of walking was studied in six subjects before and after an experiment during which they were confined to bed in the supine position for an extended period. Studies of the gait of the subjects produced data indicating reconstruction of the original stereotype of walking. A relative shortening of the distance covered in a double step and the symmetry between its component elements were noted. A change in the habitual kinematics of the trunk and extremities and disturbance of the ability to walk a straight line also occurred. Use of physical conditioning as a prophylactic measure reduces but does not eliminate the detrimental effects of prolonged hypodynamia. Use of the physical conditioning appliances in the supine position results in development of a new stereotype whose stability is greater the closer the similarity between the motions and load of the motor apparatus.
Author

N70-42871*# Scripta Technica, Inc., Washington, D.C.
STATE OF PSYCHIC ACTIVITY IN SUBJECTS DURING PROLONGED CONFINEMENT TO BED
V. P. Bogachenko *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 170–174 (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Distinct changes in psychic state were studied in subjects who were strictly confined to bed and did not perform physical exercises or receive medication during confinement. The changes were less distinct in the group of individuals who performed specially designed physical exercises. In the two series of experiments in which a composite set of prophylactic measures was applied, practically no changes in the psychic state were detected. The decisive factor in the development of the neuropsychic disturbances was forced immobility.
Author

N70-42872*# Scripta Technica, Inc., Washington, D.C.
STABILITY OF PSYCHIC FUNCTIONS DURING PROLONGED CONFINEMENT TO BED
V. L. Marishchuk et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 175–183 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Undesirable changes in the psychic functions were investigated in relation to vegetative shifts. The subjects generally retained operational efficiency and matched their original scores or improved on them as a result of training in tests of memory, the stability, distribution, and transfer of attention, sensomotor reactions, accuracy of time-interval judgment, and mentation efficiency. Some of the minor changes had an initial tendency toward deterioration, with a subsequent improvement of the indicators on the function-mobilization pattern, resembling the anxiety reaction to a state of stress, especially during periods when psychopharmaceuticals were being given. The detrimental changes were less frequent in the groups who performed physical exercises. The decrease in emotional stability and the increase in the numbers of errors are explained by preferential weakening of the inhibitory process. Author

N70-42873*# Scripta Technica, Inc., Washington, D.C.
INFLUENCE OF PROLONGED HYPODYNAMIA ON THE STATE OF THE VESTIBULAR ANALYZER
K. L. Khilov et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 184–191 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Phasing was observed in the excitability changes of the vestibular analyzer. The largest changes were noted on the 7th, 10th, and 20th days of hypodynamia in individuals whose vestibular function was found to be asymmetric before the experiment. The transition to active movement after hypodynamia was accompanied by vestibular function disorder, with normalization only after 2 to 3 weeks. It is concluded that the functions of both vestibular analyzer receptors are disturbed during hypodynamia, but that the otolith apparatus is more strongly affected. Author

N70-42874*# Scripta Technica, Inc., Washington, D.C.
STATE OF THE VISUAL ANALYZER DURING HYPODYNAMIA
N. T. Drozdova et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 192–195 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

A decrease in certain visual functions and a change in the fundus picture of the eye were observed from effects of prolonged hypodynamia on the visual analyzer. Visual acuity decreased by 21% and intraocular pressure by 3 mm Hg; there was a 15 deg loss in peripheral vision, the point of clear vision had moved out 4.5 cm, the size of the blind spot had increased by 38%, and there was a 120% increase in the time to recover visual acuity after flashing light in the eyes. Reactive vascular effects were noted on the fundus of the eye: the veins were dilated, tensed, and darker in color. The optic disk had faded. The transition to motor activity resulted in gradual recovery of the disturbed functions. Author

N70-42875*# Scripta Technica, Inc., Washington, D.C.
PHYSICAL CONDITIONING FOR MAN UNDER CONDITIONS OF PROLONGED HYPODYNAMIA
A. V. Yeremin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 196–204 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Under conditions of artificially suppressed physical activity and prolonged confinement to the horizontal position the use of specific sets of physical exercises were studied to reduce hypodynamic shifts, especially with respect to the strength of various muscle groups, static endurance, the coordination habits of walking and pyschomotor functions. Exercising on a treadmill appliance has advantages over the bicycle ergometer because of the prophylactic and emotional effects of the exercises. Author

N70-42876*# Scripta Technica, Inc., Washington, D.C.
OCCLUSION CONDITIONING UNDER THE CONDITIONS OF PROLONGED HYPODYNAMIA
V. G. Voloshin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 205–210 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

A technique is examined in which inflatable thigh cuffs are applied as a measure against the unfavorable effects of prolonged hypodynamia on the cardiovascular system. The operating principle of a machine that automatically maintains a specified occlusion-conditioning regime is described. The results of completed tests are presented and the prophylactic procedure in question is evaluated. Author

N70-42877*# Scripta Technica, Inc., Washington, D.C.
RESULTS FROM USE OF MEDICATION IN INDIVIDUALS SUBJECT TO PROLONGED HYPOKINESIA
P. V. Vasil'yev et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 211–218 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The influence of prolonged hypokinesia on the reactivity of the organism with respect to a combination of medications (amphetamine, securinine, caffeine) and the possibility of improving human tolerance to orthostatic loads and the action of transverse G-forces with the aid of these drugs were studied in experiments in which 11 subjects participated. It was established that the action of the medication changed under hypodynamia; in most cases, the effect was weaker, and inversion occurred in a number of observations. As a rule, tolerance of orthostatic loading and G-forces increased following administration of the above agents, especially when they were given to individuals who performed a set of physical exercises. In all cases, the decrease or increase in the subjects' stability after hypodynamia was arrived at with considerably greater stressing of the organism's functional systems than was observed before hypokinesia. Author

N70-42878*# Scripta Technica, Inc., Washington, D.C.
STATE OF NERVOUS-SYSTEM FUNCTIONS DURING AFTEREFFECTS OF HYPODYNAMIA
G. S. Kalin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 219–226 (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Distinct disturbances to the functions of the nervous system and the neuropsychic sphere were detected in subjects after prolonged hypodynamia. Organic microsymptomatics, asthenia, vegetative cardiac instability, and akinetic hypotrophy of the muscles of the lower leg were noted. After load tests administered at the end of hypodynamia, the changes in the animal nervous system increased. There was a certain tendency to preferential weakening of the left (dominant) hemisphere of the brain (the appearance of occasional signs of dextral pyramidal and sinistral cerebellar insufficiency). Subjects who participated in the hypodynamia experiments without preventive measures showed more pronounced functional disturbances; the disturbances were less hypodynamia was combined with physical exercises on a treadmill and with autogenous conditioning. Author

N70-42879*# Scripta Technica, Inc., Washington, D.C.
RESULTS OF INVESTIGATIONS OF THE CARDIOVASCULAR SYSTEM DURING THE AFTEREFFECT OF 70-DAY HYPODYNAMIA
A. V. Beregovkin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 227–233 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Data on the aftereffect of prolonged hypokinesia are presented and the effectiveness of the preventive measures taken against its

unfavorable effects is evaluated on the basis of the stability and degree of the changes in the circulatory system. During 1 to 3 days before the start of the experiment and in the afterperiod until the changes noted had vanished, the subjects were examined by a therapist who used generally accepted clinical methods; electrocardiograms were recorded and hemodynamics was studied by N.N. Savitskiy's method at rest, after measured physical exertion, and during the passive orthostatic test. Electrocardiographic examination during the afterperiod showed a change in the bioelectrical activity of the heart and disturbance of metabolic processes in the myocardium. The hemodynamic changes indicate disturbance of cardiovascular regulation and poor adaptation of the system to physical exertion and orthostatic disturbances. Author

N70-42880*# Scripta Technica, Inc., Washington, D.C.
REGIONAL ARTERIAL OSCILLOGRAPHIC INDICES DURING HYPODYNAMIA
Ye. G. Ryabkova et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 234–237 (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Oscillograms from symmetrical zones of the upper arms and lower legs, the Korotkov arterial pressure, and pulse frequency were registered systematically over the course of the experiments. Prolonged hypodynamia resulted in neurocirculatory dystonia, which appeared in asynchronous variations of arterial pressure and vascular tone and asymmetry and instability of the vascular reactions. Author

N70-42881*# Scripta Technica, Inc., Washington, D.C.
AN INVESTIGATION OF ORTHOSTATIC STABILITY AFTER PROLONGED HYPODYNAMIA
I. D. Pestov et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 238–247 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The reactions of the cardiovascular system to the orthostatic test are examined in men who were restricted to the horizontal position for 70 days. Certain prophylactic measures taken against detrimental effects of prolonged hypodynamia are evaluated. The possible mechanisms of the orthostatic disturbances that result from simulation of weightlessness are discussed. Author

N70-42882*# Scripta Technica, Inc., Washington, D.C.
CHANGE IN LOAD-FACTOR TOLERANCE AFTER 70 DAYS OF HYPODYNAMIA
A. R. Kotovskaya et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 248–255 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

Stability to the action of transverse g-forces was investigated in 12 subjects before and after a prolonged (70-day) confinement to bed. Overload tolerance was evaluated in terms of the maximum g-force at which the first signs of physiological function disturbance made their appearance, and on the basis of shifts in the physiological reactions during and after action of the load factor. A distinct decrease in the tolerance to transversely directed g-forces was noted after bed rest. Use of drugs and physical exercises during hypodynamia was clearly helpful. The combination of prophylactic measures resulted in an increase in the maximum load factor tolerated after hypodynamia without any substantial decrease of overall stability. In all cases, however, the physiological systems were more severely stressed under a given g-force after hypodynamia. Author

N70-42883*# Scripta Technica, Inc., Washington, D.C.
BASIC RESULTS FROM STUDIES OF THE INFLUENCE OF 70-DAY HYPODYNAMIA ON THE HUMAN ORGANISM
A. M. Genin et al *In its* Probl. of Space Biol., Vol. 13 Oct. 1970 p 256–262 refs (See N70-42851 24-04)
Avail: NTIS CSCL 06S

The results obtained during the experiment are examined in juxtaposition to the expected consequences of hypodynamia, which are presented in diagram form. Certain aspects of the influence of prolonged bed rest on the organism are revealed: a decrease in immunological resistance, certain disturbances to the mental functions, the development of trophic changes in the myocardium, and changes in reactivity to medication. The specifically designed physical conditioning procedures were found to be relatively effective in mitigating the detrimental effect of hypodynamia. Author

N70-42894# University of Southern Calif., Los Angeles.
ESR STUDIES ON THIYL FREE RADICALS IN RELATION TO BIOLOGICAL EFFECTS OF RADIATION Progress Report
Walter Wolf 1 Mar. 1970 43 p refs
(Contract AT(11-1)-113)
(USC-113-P-21-X-2) Avail: NTIS

Studied are the ESR characteristics of thiyl and related free radicals, in order to achieve a better understanding of the role of mercapto-containing compounds, both in radiation damage and radiation protection processes. The oxidation of thiols with ceric ion, in solution, leads to a number of free radical signals, ascribable to at least 6 different species. Correlations between the coupling constants and structure suggest possible means of identifying free radical sites, of potential interest for polypeptide and protein studies. At this time, the ceric ion remains the most versatile oxidizing system; attempts to use other homogeneous or heterogeneous phase one-electron transfer agents were unsuccessful. Author (NSA)

N70-42907# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
INFLUENCE OF TEMPERATURE DURING THE GAMMA IRRADIATION THERMOLUMINESCENCE OF SOILS AND LiF AND CaF2 DOSIMETERS
H. Nishita and M. Hamilton [1970] 20 p refs
(Contract AT(04-1)-Gen-12)
(UCLA-12-781) Avail: NTIS

The influence of temperature (0 deg to 70 C) during the exposure period to cobalt-60 gamma radiation on the thermoluminescence of two soils and LiF (TLD-100) and CaF2 (TLD-200) dosimeters was examined. The thermoluminescence of these materials was affected by their temperature during irradiation. The effect of temperature during irradiation was eliminated in the soils by using a pre-readout, post-irradiation heating regimen of 100 C for 20 min or by allowing the thermoluminescent decay to progress for an appropriate length of time. For the two soils examined, this time was about 58 and 168 hr. The pre-readout, post-irradiation heating regimen (100 C for 10 min) sometimes used for TLD-100 and TLD-200 dosimeters did not eliminate the effect of temperature during irradiation. Author (NSA)

N70-42971# Atomic Energy Commission, New York. Health and Safety Lab.
CALCULATION OF DOSE AND DOSE-EQUIVALENT RATES TO MAN IN THE ATMOSPHERE FROM GALACTIC COSMIC RAYS
Keran O'Brien and James E. McLaughlin May 1970 22 p refs
(HASL-228) Avail: NTIS

An accelerator shielding code LUIN was adapted to the calculation of galactic cosmic-ray ionization, dose rates, and dose-equivalent rates as functions of altitude. Comparisons with spectral measurements were made and agreement is generally good. The sea-level ionization density and the derived dose-equivalent rates also agreed acceptably well with comparable measurements. Agreement among estimates of neutron dose rates was only fair, probably because of inadequately defined detector responses and dose models. The calculations permitted a parametric study of variations due to latitude and altitude, and such a study is now underway. Author (TAB)

N70-43009*# McDonnell-Douglas Co., St. Louis, Mo.
SPACE SHUTTLE MAN-MACHINE INTEGRATION AND AEROMEDICAL TECHNOLOGY REQUIREMENTS
E. R. Jones *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 7 Jul. 1970 p 59-74 (See N70-43004 24-30)
Avail: NTIS CSCL 05H

Shuttle-specific independent research and development (IRAD) is described along with shuttle-related IRAD, contract research and development, and hardware developments. A briefing in October 1969 on man-machine integration and aeromedical technology requirements for space shuttles is reviewed and related to further definition of the system. It is concluded that existing technology activities are not readily adaptable to the central issues of shuttle vehicles. Based upon the survey and the technology gaps, recommendations are given in broad categories of man-machine integration and aeromedical technology. Author

N70-43035# Arizona State Univ., Tempe.
A SYSTEM FOR STUDIES OF HYPERBARIC ENVIRONMENT EFFECTS ON PRIMATE BEHAVIOR AND PHYSIOLOGY
Dwight Sutton and Eugene M. Taylor 1 Aug. 1970 27 p
(Contract N00014-68-A-0150)
(AD-710419; TR-70-01) Avail: NTIS CSCL 6/12

The report describes a small (5 ft. i.d.) hyperbaric chamber together with associated features designed for the purpose of studying primate behavioral and physiological capacities. The chamber is rated for work at pressures equivalent to 2000 FSW and can be utilized for extended studies of performance under saturation conditions. Basic functions of chamber operation and gas control are automated and can be placed under programmed control of a computer (LINC-8). Up to five gases may be used simultaneously. Apparatus assembled for the analysis of neuromuscular control and of cardiovascular responses under hyperbaric stress is described. Author (TAB)

N70-43049# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
HUMAN STRENGTH: TERMINOLOGY, MEASUREMENT, AND INTERPRETATION OF DATA
K. H. Eberhard Kroemer May 1970 33 p refs
(AD-710593; AMRL-TR-69-9) Avail: NTIS CSCL 5/5

Application of strength data to human engineering problems is often hampered by ambiguities of both terminology and data. This paper attempts to point out some of the problems. After defining strength and clarifying related terms, mechanical, physiological and statistical implications of strength testing are discussed. Strength data are considered to be fully relevant to human engineering problems only if the operator must exert maximal static muscle force. If submaximal forces are required, the applicability of strength data is very limited. Research is needed to establish relations between human static force capacity and the abilities to perform maximal or submaximal dynamic work. At present there is little evidence that static force data accurately predict dynamic performance. Author (TAB)

N70-43089# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TOXICITY AND THE NATURE OF THE ACTION OF FLUORINATED ALCOHOLS (TRIFLUOROETHANOL AND 1,1-DIHYDROPERFLUOROBUTANOL)
T. K. Nikitenko et al 28 May 1970 12 p refs Transl. into ENGLISH from Gig. Tr. Prof. Zabol. (Moscow), v. 13, no. 10, 1969 p 29-33
(AD-710292; FTD-HT-23-233-70) Avail: NTIS CSCL 6/20

The paper discusses the toxic action of fluorated alcohols (trifluoroethanol and 1,1-dihyperfluorobutanol) and different routes of their access into the organism of experimental animals. The fluorated alcohols under study are shown to be toxic compounds. Topical irritating action at the site of their application and general toxic effect of these poisons, characterized by manifestations of their narcotic action on the central nervous system and by dystrophic changes in parenchymatous organs, were revealed. Maximum permissible concentrations of their fumes in the air of industrial premises have been established, which for trifluoroethsnol is 10 mg/cu m and for 1,1-dihydroperfluorobutanol - 20 mg/cum. Author (TAB)

N70-43096*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECT OF ENVIRONMENT ON BIOLOGICAL BURDEN DURING SPACECRAFT ASSEMBLY
D. M. Taylor, G. H. Redmann, A. R. Hoffman, and M. D. Wardle 1 Dec. 1969 35 p refs
(Contract NAS7-100)
(NASA-CR-110875; JPL-900-345) Avail: NTIS CSCL 06M

Three environments were selected: a typical high-bay manufacturing area having a Class 100,000 cleanliness, a 16 × 16 ft Class 100 laminar downflow tent, and the Sterilization Assembly Development Laboratory (SADL) 30 × 40 Class 100 laminar downflow assembly room with personnel and equipment entry control systems. The test item, assembled under these varying conditions, was a 14 ft diameter capsule mechanical training model, consiting of mockups of the major subassemblies expected to comprise a typical spacecraft capsule. The complete encapsulation of the capsule in a biobarrier was the terminal step of the assembly process. The results of the study program show that there are no significant effects on the aerobic spore accumulation due to environment; however, there is an effect on the control of aerobic vegetative cells. The configuration of the spacecraft surfaces and their exposure to the environment has an effect on the bioburden accumulation in all three test environments. Author

N70-43124*# Missouri Univ., Columbia.
GAS-LIQUID CHROMATOGRAPHY OF AMINO ACIDS IN BIOLOGICAL SUBSTANCES
Robert W. Zumwalt, Don Roach, and Charles W. Gehrke [1969] 57 p refs Sponsored in part by Dept. of Agr.
(Grants NGR-26-004-011; NSF GB-7182)
(NASA-CR-110882) Avail: NTIS CSCL 06A

The development of a gas-liquid chromatographic (GLC) method for the quantitative analysis of amino acids in complex biological substances, specifically blood plasma and urine, is discussed. The amino acids present in these physiological fluids were quantitatively isolated by ion-exchange methods and retained on the ion-exchange resin while the substances which interfere with the GLC analysis passed through the column and were discarded. The amino acids were then eluted from the column, derivatized to their N-TFA n-butyl esters and analyzed by GLC. Quantitative recovery of the amino acids from the cation and anion-exchange cleanup columns, and amino acids in blood and urine were carried out. Author

N70-43129# Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences.
KINETICS OF CELLULAR PROLIFERATION IN THE SEMINIFEROUS EPITHELIUM UNDER CONTINUOUS IRRADIATION
Jacob I. Fabrikant 6 Oct. 1969 23 p refs Presented at 12th Intern. Congr. of Radiology, Tokyo, 6-11 Oct. 1969
(Contract AT(30-1)-3970)
(NYO-3970-30; CONF-691021-3) Avail: NTIS

Under continuous gamma irradiation, cell renewal during spermatogenesis in the mouse could achieve a near-steady state of cell population at a dose rate of 1.8 rads/day or less for at least 15 weeks by limited mechanisms of compensatory cell proliferation.

Changes in the patterns of spermatogonial cell population kinetics indicated there was some reserve of proliferative capacity, but the extent to which these changes were caused by decreasing the cell cycle time of a precursor subpopulation in the type A cell compartment, or the bringing-in of a potentially proliferative dormant A sub 0 cell population, is not, as yet, clearly understood. Both mechanisms may be important in maintaining the steady state of spermatogenesis. Autoradiographic data indicated that there was a delay in the flow of spermatogonia in each proliferative compartment from the post-synthetic period into cell division, associated with a decrease in the duration of DNA synthesis, but with a normal cell cycle time. There was a slight differential radiosensitivity among spermatogonia affecting proliferation. NSA

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N70-41819* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

UNIVERSAL PILOT RESTRAINT SUIT AND BODY SUPPORT THEREFOR Patent

Hubert C. Vykukal, inventor (to NASA) Issued 7 Feb. 1967 (Filed 12 Dec. 1961) 15 p Cl. 128-1

(NASA-Case-XAC-00405; US-Patent-3,302,633; US-Patent-Appl-SN-158916 Avail: US Patent Office CSCL 06Q

An astronaut restraint suit which eliminates the need for a contoured couch is described. The posterior portion of the body is supported by a rigid chair-like structure used with the suit which also has a rigid support structure and may be attached to the chair. The suit is adjustable to different sized pilots by inflating bladders. A latch arrangement between the suit and support structure provides rapid ingress and egress. The restraint suit allows movement of the arm for manipulating controls and is lightweight. N.E.N.

N70-41904*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATION OF MODERN NETWORK THEORY TO ANALYSIS OF MANNED SYSTEMS

John C. Fakan Washington Oct. 1970 42 p refs

(NASA-TN-D-6034; E-5612) Avail: NTIS CSCL 06K

The techniques of Modern Network Theory are modified and expanded to provide a generalized methodology for the analysis of systems that contain man as a functioning part. An approach to the formulation of the systems equations that describe a human subsystem, by characterizing the phenomenological appearance of man in each of his functional roles, is described. The problems associated with metering of the significant human parameters are discussed, and a series of physiological measurements are described which indicate that human heart rate can provide a useful measure of total work output in the engineering sense. A sample man-machine system modeled after an experience of two men involved in a representative system of this type is presented, along with a series of results which demonstrate the recovery response of this system to stochastic perturbations. A FORTRAN 4 computer program developed for the analysis of this type of system is included in the appendix. Further possible uses for the generalized methodology are suggested, including the analysis of urban renewal, finance, and social behavior problems as well as analyses of proposed manned planetary expeditions. Author

N70-41934# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

DEVELOPMENT OF PRACTICAL HIGH-INTENSITY THERMAL PROTECTION SYSTEMS Interim Report

Alice M. Stoll, Maria A. Chianta, and L. B. Judge 14 Jul. 1970 21 p

(AD-709570; NADC-MR-7016) Avail: NTIS CSCL 6/17

The military requirement for high-intensity thermal protection entails provision of a system which is effective in the nuclear weapon range and at the same time practical from the logistics point of view and comfortable for extended periods of wear. With these ends in mind, small-scale laboratory procedures and full-scale evaluation procedures were devised whereby specific systems could be designed to meet specific needs. Thermal barriers were designed through application of basic heat transfer principles with careful consideration for the influence of thermal and optical properties of materials on heat exchange. In the present example a green assembly was developed to replace a white one designed for protection of flight personnel from the thermal effects of nuclear weapons. In thermal exposures delivering approximately 50 cal/(sq cm) in 2 seconds in some areas, with an overall average of about 20 cal/(sq cm) in 2 seconds, the new system offered protection equal to that of the white assembly while weighing only half as much and representing significant advantages in comfort and logistics. The procedures developed in this study are general in nature and widely applicable to the development of other thermal protection systems. Author (TAB)

N70-41980*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

OPEN TYPE URINE RECEPTACLE Patent Application

Anthony S. Girala, inventor (to NASA) Filed 13 Aug. 1970 10 p

(NASA-Case-MSC-12324-1; US-Patent-Appl-SN-63384) Avail: NTIS CSCL 06I

An open type urine receptacle comprising a tubular housing having an inlet and an outlet end is described. The housing contains a honeycomb insert for polarizing the urine stream in order to eliminate splashback. A fine mesh screen insert adapted to serve as a wicking means upon completion of micturition is supported at one end of the honeycomb insert. A receptacle cover is also provided for covering the open end of the housing and a vacuum-removal tube is connected to the other end in fluid communication with the interior. NASA

N70-42000* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MASS MEASURING SYSTEM Patent

William Lawrence Green and Richard W. Bricker, inventors (to NASA) Issued 6 Jun. 1967 (Filed 16 Dec. 1964) 7 p Cl. 73-432

(NASA-Case-XMS-03371; US-Patent-3,323,370; US-Patent-Appl-SN-418931) Avail: US Patent Office CSCL 06P

The apparatus and method for determining the mass of a human body in a zero or reduced gravity environment are described. The subject is supported by straps in an attitude normal to the local acceleration field, in a rotating space station. Force applied by the body to the straps is determined from load cell output signals, and the acceleration to which the subject is subjected is read on an accelerometer or is determined by measurement of the space station's angular velocity. N.E.N.

N70-42123# Catholic Univ. of America, Washington, D.C.

CRASHWORTHINESS AND BIOMECHANICS OF VEHICLE IMPACT

Nicholas Perrone Sep. 1970 41 p refs Proposed for presentation at Colloq. on Dyn. Response of Biomech. Systems, ASME Ann. Meeting, New York, 2 Dec. 1970

(Grant NSF GK-23747) Avail: Issuing Activity

The title problem is considered in a fairly self-contained manner. Firstly, background information is provided indicating the seriousness of vehicle impact as well as a detailed profile of the problem. The changing or dynamic nature of the field is observed by considering innovations of the last few years that have had a significant effect on safety level. Major difficulties that arise when one attempts to design for impact attenuation are examined and an approach is suggested to overcome these problems, namely use of a unit crashworthy element. The transversely loaded tube is recommended as one worth-while possibility. Airbag systems, which are candidates for massive deployment in new cars during the next few years, are considered to be a very favorable development but should be approached with caution. Even after these systems have reached a high degree of reliability, they should be phased in on a stepped basis over a 2–4 year time period. Energy absorbing systems ranging from frangible tubes to frame assemblies are examined and some general assessments given of the potentials of the various candidate systems. Author

N70-42253# Battelle Memorial Inst., Columbus, Ohio.
PROCEEDINGS PURITY STANDARDS FOR DIVERS BREATHING GAS SYMPOSIUM
9 Jul. 1970 335 p refs Symp. held at Columbus, Ohio, 8-9 Jul. 1970
(Contract N00014-70-C-0072)
(AD-710006; SUPDIVE-RR-6-70) Avail: NTIS CSCL 6/11

Reported incidents of gross contamination in some of the divers breathing air systems on board U. S. Navy ships initiated an extensive effort to minimize this condition. The methods for such minimizations have been investigated and resulting techniques are being implemented. However, the source of contamination and the resultant physiological effect in a hyperbaric environment are not well established. A symposium was held as a first step towards a more adequate definition of purity standards. The symposium covered the following topics: Physiological effects; Gas processing; Gas monitoring; and Divers support system design. Author (TAB)

N70-42268*# Aerojet-General Corp., El Monte, Calif. Aerojet Medical and Biological Systems.
DESIGN FEASIBILITY STUDY FOR CONSTRUCTION OF A MICROBIAL ECOLOGY EVALUATION DEVICE (MEED) Final Report
A. M. Taylor Sep. 1970 201 p
(Contract NAS9-10820)
(NASA-CR-108661) Avail: NTIS CSCL 06B

A discussion of the results of the feasibility investigations and the conclusions reached, data on alternate designs, a recommended design approach, and the major protocols that define the procedures required for use of the hardware are included. Long-duration space missions may result in microbial mutants that are more virulent than the initial microbial forms. The conditions that may lead to the mutations are: (1) lowered gravity states, (2) ultra-violet irradiation, (3) variations of the oxygen content in the environment, and (4) exposure to the hard vacuum of space. The equipment microbial ecology evaluation device (MEED) can be developed and used in space experiments to determine the effects of these environmental factors on selected microbial systems. The general plan for the proposed flight experiments is to carry three packages MEEDs of microbial samples to the lunar surface, where two will be exposed to the solar radiation of space. The third MEED will serve as an unexposed control unit on the lunar surface. A fourth MEED will be an unexposed control unit in orbit around the moon in the Command Module. A fifth MEED will be kept as a control unit under carefully controlled conditions at the Manned Spacecraft Center, Houston. This study had the objective of establishing the feasibility of designing and fabricating hardware for the proposed flight experiments. Requirements were defined, concepts were evaluated, selected hardware was fabricated, analyses and feasibility tests were performed and a mock-up of the flight assembly was completed. Author

N70-42274# United Aircraft Corp., Norwalk, Conn. Norden Div.
INTEGRATED VERTICAL DISPLAY RESEARCH. Final Technical Report
Harold C. Wooding, Jr., John A. Simpson, H. Harper, and R. Sweetnam Jul. 1970 163 p refs
(Contract Nonr-4489(00))
(AD-709460; Rept-1161-R-0037; JANAIR-680611) Avail: NTIS CSCL 1/4

Simulation studies were conducted with eight civilian and military pilot subjects. A series of flight maneuvers were performed using a hypothetical tilt-wing vehicle, and the integrated electronic vertical display (IEVD) with a set of conventional instruments. Comprehensive data acquisition, computation and online printout of error scores were utilized. Data reduction and statistical analysis ensued to determine the efficacy of performance to the criteria model and to the set of conventional instruments. Author (TAB)

N70-42278*# Virginia Univ., Charlottesville. Div. of Biomedical Engineering.
TECHNOLOGY TRANSFER IN BIOMEDICAL ENGINEERING Final Report, 1 Sep. 1969 – 30 Jun. 1970
Michael L. McCartney Jul. 1970 53 p refs
(Grant NGL-47-005-014)
(NASA-CR-114242; BioM-4070-101-70U) Avail: NTIS CSCL 06B

A mechanism for transfer of aerospace technology appropriate to biomedical problems was designed and put into operation. Problems have been received from each of NASA's Biomedical Applications Teams and are in various locations within the transfer system herein described. The creation of an application engineering center, the generation of its operational guidelines, and the recommendations for improvements in the transfer system as viewed by the facility responsible for reengineering technology are discussed. Individual projects are presented for illustrative purposes. Author

N70-42279# Congress. House. Committee on Interstate and Foreign Commerce.
CLEAN AIR ACT AMENDMENTS OF 1970
Staggers Washington GPO 1970 53 p refs Rept. to accompany H.R. 17255 presented by the Comm. on Interstate and Foreign Com. at the 91st Congr., 2d Sess., 3 Jun. 1970
(Rept-91-1146) Avail: US Capitol, House Document Room

The Committee on Interstate and Foreign Commerce presents the amendments of the Clean Air Act of 1970. Emphasis is placed on the community responsibility in implementing and enforcing the strategies outlined. Prompt and effective efforts are urged to win the campaign for clean air. The committee further recommends that the Federal Government provide technical and financial assistance to State and local governments in connection with the development and execution of their air pollution and control programs. E.M.C.

N70-42282*# Hughes Aircraft Co., Fullerton, Calif.
HUMAN RELIABILITY STUDY, PHASE 1 Final Report, Jan. – Jul. 1970
Jul. 1970 230 p refs
(Contract NAS10-6976)
(NASA-CR-110781; GP-891) Avail: NTIS CSCL 05H

An investigation was performed to determine the reliability, validity, and completeness of published industrial safety data for the purpose of predicting personnel hazard resulting from human error. Technical papers, safety publications, and industrial data

banks were collected, reviewed, and assembled into a complete safety bibliography; those sources having direct impact on the present study were collected into a smaller, annotated bibliography. Author

N70-42364*# Louisville Univ., Ky.
PERFORMANCE MEASUREMENT OF NONVERBAL MEDIATION: A DIGITAL READOUT VERSION OF THE CODE TRANSFORMATION TASK (DR-COTRAN)
Earl A. Alluisi, Ben B. Morgan, Jr., and Thomas K. Dempsey 1970 73 p refs
(Grant NGR-18-002-008)
(NASA-CR-114234) Avail: NTIS CSCL 05H

The first two experiments compared the factorial structures of the DR-COTRAN and 3P-COTRAN tasks, and the relative sensitivities of the two versions to practice effects and to the effects of infectious disease (subjects ill with Sandfly fever) when both tasks were used alone without any requirement for time-sharing. The third study measured the acquisition of skill on the DR-COTRAN task and the influence of practice on the nonverbal mediation measured with the task. The fourth investigation measured the effects of operator loading on DR-COTRAN performances, and, conversely, the effects of adding the DR-COTRAN task to various combinations of tasks currently employed in a multiple-task performance (MTP) battery. The DR-COTRAN task permits the measurement of the same nonverbal-mediational aspects of intellectual functioning as provided for in the third, or problem-solving, phase of 3P-COTRAN task. The two versions of the COTRAN task differ in terms of some apparently nonessential characteristics, and in these cases the differences favor the DR-COTRAN version for use as an additional task in the MTP battery. Author

N70-42445*# Louisiana State Univ., Baton Rouge, La. Div. of Engineering Research.
THE CONSTRUCTION OF A CHEMICAL-MICROBIAL PILOT PLANT FOR THE PRODUCTION OF SINGLE CELL PROTEIN FROM CELLULOSIC WASTES
C. E. Dunlap [1970] 143 p refs
(Grant NGL-19-001-024)
(NASA-CR-114241) Avail: NTIS CSCL 13B

A pilot plant was designed, constructed, and operated which produced microbial single cell protein from waste sugar cane bagasse. Bagasse was ground and given a mild alkaline-oxidation treatment prior to fermentation. Bagasse was slurried at up to 10.0 grams per liter dry weight in water with a simple nutrient salts mixture to form the fermenter feed stream. The process was operated in both batch and continuous flow patterns. Cellulomonas, gn. bacteria were used in a pure culture for most runs, but a mixed culture run of cellulomonas and the symbiotic organism alcaligenes fecaelis showed much higher production capabilities. Maximum cell density obtained with pure cellulomonas was 1.7 grams dry weight per liter, and 6.24 grams per liter for the mixed culture. Culture mass doubling times during log phase growth were usually from 3.2 to 3.7 hours. Single cell protein was produced as a light brown to yellow-brown powder, and had a crude protein content of 50 to 55 percent. Preliminary cost analysis showed a production cost of from 10 to 15 cents per pound of dry cells. Author

N70-42522*# Battelle Memorial Inst., Columbus, Ohio.
CONTINUOUS CATALYTIC DECOMPOSITION OF METHANE
B. C. Kim, J. Zupan, L. Hillenbrand, and J. E. Clifford Washington NASA Oct. 1970 63 p refs
(Contract NAS2-5051)
(NASA-CR-1662) Avail: NTIS CSCL 06K

Experimental studies of catalysts for decomposition of methane and process design studies were directed to the problems of carbon production in a high-temperature reaction required for one subsystem of the closed Sabatier system as applied to space life support. The basis for a new reactor design for continuous carbon removal in a gravity-independent manner was demonstrated; a rotating magnetic field was used to support the catalyst in the flowing methane stream and to confine the catalyst bed within the high temperature reaction zone until a high catalyst utilization was achieved. For this purpose, the preferred catalyst was cobalt powder, which maintains magnetic properties above the desired reaction temperature of 850 C. On the basis of the experimental data obtained, a methane decomposition reactor having a catalyst bed volume of about 1 liter was designed for a nominal 3-man system. Author

N70-42535# Naval Research Lab., Washington, D.C.
CHEMICAL RESEARCH IN NUCLEAR SUBMARINE ATMOSPHERE PURIFICATION Progress Report
V. R. Piatt and E. A. Ramskill 2 Jun. 1970 2 p refs
(AD-709896; NRL-7037) Avail: NTIS CSCL 6/11

Considerable progress has been made in developing both laboratory and shipboard methods of sampling, analysis, and control, but major shipboard analytical equipment continues to be of marginal quality. Some of the topics covered include a fire-retardant and nontoxic paint system for application when necessary during submergence, atmospheric contamination with a cleaning solvent, the NRL Total Hydrocarbon Analyzer, catalyzed combustion of various types of atmospheric contaminants, and CO2 absorption properties of some new amines. Author (TAB)

N70-42560# Battelle Inst., Frankfurt am Main (West Germany).
ANALYSIS OF COLLOIDAL AIR AND WATER POLLUTION BY LIGHT SCATTERING
Jan Bol, Josef Gebhart, Christa Roth, and Gerhard Wurzbacher *In its* Battelle Inform. No. 5 Aug. 1969 p 23-29 refs (See N70-42557 24-34)
Avail: NTIS

Optical methods for measuring the sizes of colloidal particles and their concentrations in polluted air and water are described. The methods are based on Mie forward light scattering and make use of lasers. ESRO

N70-42646# Toronto Univ., (Ontario). Inst. for Aerospace Studies.
AN INVESTIGATION INTO CERTAIN ASPECTS OF THE DESCRIBING FUNCTION OF A HUMAN OPERATOR CONTROLLING A SYSTEM OF ONE DEGREE OF FREEDOM
M. Gordon-Smith Feb. 1970 159 p refs
(Grant AF-AFOSR-1490-68)
(AD-710206; UTIAS-149; AFOSR-70-2197TR) Avail: NTIS CSCL 5/8

An experimental investigation was carried out of the remnant portion of the mathematical model of the human operator. This model consists of the combination of a quasilinear describing function and a remnant term. A single-axis tracking task, with random forcing functions and a compensatory display, was used to investigate the effect of the type of manipulator and the bandwidth of the forcing function on the remnant. Pressure and free-moving manipulator were employed with rate-control vehicle dynamics and filtered-white-noise forcing functions similar in spectral shape to those used in previous work. Data is presented which show the effects of the manipulator and of the forcing function on the describing function, on the performance measures of the system and on the power spectrum and the amplitude probability distribution of the remnant. Author (TAB)

N70-42666*# Techtran Corp., Glen Burnie, Md.
REGENERATION OF THE ATMOSPHERE IN SPACECRAFT CABINS USING UNICELLAR ALGAE [REGENERATSIYA ATMOSFERY KABIN KOSMICHESKIKH KORABLEI S

ISPOL'ZOVANIEM ODNOKLETOCHNYKH VODOROSLEY]
G. I. Meleshko Washington NASA Oct. 1970 8 p refs Transl. into ENGLISH from 21st Intern. Astronautical Congr. (Constance, Moscow), 4–10 Oct. 1970 8 p
(Contract NASw-2037)
(NASA-TT-F-13377) Avail: NTIS CSCL 06K

The development of air regeneration systems utilizing photosynthesis of unicellular algae is discussed with respect to the efficiency of current bioengineering systems used for Chlorella cultivation and the possibility of assuring stable performance of the systems. The efficiency of cultivation procedures is achieved first of all by reuse of the culture medium without its intermediate treatment in adjacent components of the system. Stability of the system is related to biological peculiarities of the biological material (populations involving specimens of different age and high reproduction rate) and can be maintained by certain techniques. The practical efficiency of air regeneration systems based on Chlorella cultivation may increase provided that the Chlorella culture performs some additional functions in the life support system (urine utilization, water evaporation during its reclamation, and cabin air purification from man-produced contaminants). Author

N70-42745# Little (Arthur D.), Inc., Cambridge, Mass.
MEMBRANE SYSTEMS FOR CARBON DIOXIDE AND WATER VAPOR TRANSPORT Final Report, 21 Jun. 1968–15 Dec. 1969
John M. Ketteringham, Dexter D. Snyder, and Douglas Shooter Wright-Patterson AFB, Ohio AMRL Mar. 1970 108 p refs
(Contract F33615-69-C-1223)
(AD-710404; ADL-C-71321; AMRL-TR-70-4) Avail: NTIS CSCL 6/11

Following a preceding study of the use of a porous silica membrane system for humidity control in aircraft and space vehicles, the potential weight and volume improvements derived from the use of membranes in the form of thin tubes were investigated. A one-man capacity demonstration model of such a system taking advantage of these considerable savings was developed. Also the wasteful transport of oxygen or air at lower humidities (40-50% RH) can be significantly reduced by impregnating the pores with a desiccant solution. The usefulness of the basic system was extended by using it as a water exchanger in which a dry flushing gas stream provided the driving force across the membrane instead of a vacuum. Porous cellulose containing an aqueous solution of a reversible carbon dioxide absorbent sandwiched between hydrophobic (TFE), microporous membranes showed promise for carbon dioxide removal systems. No advantage over state of the art systems was observed for impregnated microporous silica membranes in this application. A screening program was undertaken to find a substitute for arsenites as catalysts for the absorption and facilitated transport of carbon dioxide. Tin and zinc organometallic complexes with promising properties were identified. For practical application, solubility limitations in particular will have to be overcome. Author (TAB)

N70-42926# RAND Corp., Santa Monica, Calif.
RAND SYMPOSIUM ON PILOT TRAINING AND THE PILOT CAREER: RECOLLECTIONS OF THE CHAIRMAN
W. A. Stewart Mar. 1970 17 p Conf. held at Santa Monica, Calif., 23–27 Feb. 1970 Revised
(Contract F44620-67-C-0045; Proj. RAND)
(AD-707098; RM-6282-1-PR-Rev.) Avail: NTIS CSCL 5/9

A report is made on a symposium that included Air Force officers engaged in flight training operations and in career planning, representatives of the Canadian Armed Forces and the Royal Air Force, and a cross-section of civilian research specialists in flight training problems. Topics discussed included the economics of flight training, the flying career, college versus high school graduates, defining the trained pilot, motivation and selection, innovation in pilot training, goals of training, transfer of training, and the role of simulators. TAB

N70-43006*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTEGRATED LIFE SUPPORT SYSTEMS FOR THE SPACE SHUTTLE
Robert S. Osborne and Lenwood G. Clark *In its* Space Transportation System Technol., Symp., Vol. 7 Jul. 1970 p 15–29 (See N70-43004 24-30)
Avail: NTIS CSCL 06K

A survey of environmental control and life support systems for space shuttle vehicles accomplished as part of and in conjunction with ILRV studies is discussed. The results of the research and various approaches for accomplishing some of the EC/LS functions are considered. The EC/LS systems for the orbiter vehicle are emphasized. R.B.

N70-43100# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
REMOTE CONTROLLED PHYSIOLOGICAL DATA MONITORING SYSTEM Technical Report, Jul. 1968–Feb. 1969
David A. Ratino, Adolf R. Marko, and James H. Lovin Mar. 1970 27 p
(AD-710594; AMRL-TR-69-59) Avail: NTIS CSCL 6/2

A remote controlled physiological data monitoring system was designed and built to be used on the Aerospace Medical Research Laboratory Dynamic Environment Simulator (DES), a sophisticated human centrifuge. The system grew out of the necessity to have a dependable and accurate means of monitoring physiological signals from subjects in a stressed environment like that afforded by the DES. The monitoring system is a 16 channel, hardwire physiological data transmission system capable of conditioning signals from a wide variety of sensors and amplifying them to a standard plus or minus 5 volt peak level for further processing or recording. The system is capable of self-calibration. It may be manually or computer operated. While built specifically for operation on a centrifuge, this monitoring system can be used in most kinds of experimental environments where remote controlled monitoring is advantageous. Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N70-41810 Boston Univ., Mass. Graduate School.
ELECTRON TRANSFER REACTONS OF Co(III)-COMPLEXES
Ramesh Chandra Patel (Ph.D. Thesis) 1969 229 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 69-18717

Rates of reduction of Co(III) complexes were studied with Ru(NH3)6(2+) and Cr(2+). In both cases, the reaction mechanism was previously established. The relatively rapid Cr(2+) reactions were studied by means of the stopped flow technique. For the outer-sphere Ru(NH3)6(2+) reactions, similar pseudo-nonbridging ligand effects were observed as reported previously for Fe(2+) reductions. Contrary to previous predictions, nonbridging ligand effects were found to be much smaller for the inner-sphere Cr(2+) reductions. The second order rate constants for the latter reactions were found to show either little change or a decrease, with increasing temperature, and are interpreted in terms of a multiple step reaction scheme. A linear free energy relationship is proposed to account for differences in the free energies of activation of inner-sphere and outer-sphere reactions, and is shown to be influenced primarily by differences in the thermodynamic free energy changes accompanying the reactions. Deviations from this relationship are discussed by considering the individual steps associated with inner-sphere and outer-sphere reactions. Dissert. Abstr.

N70-41822# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
CHEMICAL PRECIPITATION METHODS: COMPARATIVE STUDY
L. Hajek and J. Hajkova 1970 52 p refs
(UJV-2340-Ch) Avail: NTIS

Decontamination methods (chemical precipitation) for low and intermediate level active liquid wastes used on a worldwide scale are described. The fundamental problems of chemical precipitation, coagulation, sedimentation, and the problems of sludge treatment are considered. The experimental part deals with verification of the selected methods on typical liquid radioactive wastes. The results indicate that any of the selected methods of chemical precipitation has neither a universal character nor sufficient efficiency for the decontamination of liquid radioactive wastes, if used separately, nor an expressive advantage from the viewpoint of a pretreatment for further decontamination procedures. This fact is significant mainly from the viewpoint of a future conception of a decontamination plant in NRI based on an automated and programmed process. Author (NSA)

N70-41826 Boston Univ., Mass.
KINETICS OF SOLVATED ELECTRONS AND HYDROGEN ATOMS IN RADIOLYZED METHANOL
Kalyanasundaram Suryanarayanan (Ph.D. Thesis) 1969 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-18739

The effect of sulfuric acid on yields of H2, CH4, CH2O and ethylene glycol produced in gamma-radiolysis of air-free methanol was studied. Addition of acid increases the yields of H2, CH2O and ethylene glycol and the yields eventually become limiting. No significant effect on the yield of methane was observed. Pulse radiolytic studies of decay of the solvated electron in methanol were carried out using pulsed electrons from the Brookhaven Van de Graaff. Decay traces were obtained after repeated pulsing on the same sample. In all pulse radiolysis experiments measurements of the absorption due to solvated electron were made at 545 nm. As many as 830 pulses were deposited in the same sample. The quantitative effects of acid on product yields are analyzed in the light of pulse and competition data, and mechanistic speculations involving impurity or other suspect species are offered. Dissert. Abstr.

N70-41844*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PHYSICAL CHEMISTRY OF THE AOUELLOUL CRATER GLASS
John A. O'Keefe Oct. 1970 29 p refs Submitted for publication
(NASA-TM-X-65357; X-640-70-365) Avail: NTIS CSCL 07D

In studying aouelloul crater glass from the hypothesis that it is formed by impact on the local (Zli) sandstone, the data do not support this hypothesis. It is noted that the chemical analyses of the two materials do not agree in a satisfactory way even if the most significant discrepancies, namely those in Fe and H2O, are overlooked. The possibility that the water has escaped during a phase of shock heating is examined; it is found that the impact theory does not allow sufficient time, under the conditions of gravity and temperature, for the bubbles of water vapor to escape. The formation of the relatively homogeneous matrix glass is also difficult to understand in terms of calculated diffusion coefficients. It is particularly hard to understand how the additional iron found in the glass could have diffused through the very viscous material in the very brief time available. Measurements of the diffusion borders around lechatelierite bodies indicate that diffusion has, in fact, been negligible in the Aouelloul material. Author

N70-41866 Catholic Univ. of America, Washington, D.C.
COPPER(III) COMPOUNDS IN MOLTEN SALT MEDIA
Charles Brian Root (Ph.D. Thesis) 1969 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-18576

The preparation and stability of copper (III) compounds in a molten LiF-NaF-KF eutectic (Flinak) is discussed. Oxycuprate(III) compounds were prepared by new reactions and studied by means of thermogravimetric and differential thermal analysis techniques. Sodium oxycuprate(III) was prepared by adding CuO or Cu metal powder to molten Na2O2. Potassium oxycuprate(III), is prepared from potassium metal and excess CuO. Copper(II) oxide apparently disproportionates at approximately 900 deg to yield Ba(CuO2)2 and Cu2O in the presence of BaO. Electrochemical cells employing potassium hexafluorocuprate(III) dissolved in molten Flinak as the active cathode material showed coulombic efficiencies corresponding to the reduction of copper(III) to copper metal. Spectroscopic studies verified that copper(III) exists as a stable species in molten Flinak. The absorption spectrum of copper(II) in molten Flinak exhibits a single broad band at 11.1 kK while melts containing a mixture of copper(II) and (III) show an additional band at 27.0 kK. The 27.0 kK band is attributed to the presence of an approximately octahedral CuF6(−3) ion in the melt. Dissert. Abstr.

N70-41886*# Scientific Translation Service, Santa Barbara, Calif.
MASS SPECTROMETRY OF CARBOHYDRATES
S. Saski et al Washington NASA Oct. 1970 21 p refs Transl. into ENGLISH from Tampakushitsu Kakusan Koso (Bessotsu), v. 11, 1968 p 97−107
(Contract NASw-2035)
(NASA-TT-F-13268) Avail: NTIS CSCL 07D

The applications of mass spectrometry to organic compounds are reviewed. A description is given of the analytical techniques in mass spectrometry, including the deuterium marking method and the detection of metastable peaks. Author

N70-41913*# Translation Consultants, Ltd., Arlington, Va.
THE PHOTOCHEMICAL REACTION BETWEEN BENZONITRILE AND 2,3-DIMETHYLBUTADIENE [BENZONITORIRU TO 2,3-JIMECHIRUBUTAJIEN TO NO KOKAGAKU HANNO]
K. Okumura et al Washington NASA Oct. 1970 13 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Tokyo), v. 72, no. 1, 1969 p 200−203
(Contract NASw-2038)
(NASA-TT-F-13163) Avail: NTIS CSCL 07D

The formation of a 1:1 adduct and a diene dimer was observed in the photochemical reaction between benzonitrile and 2,3-dimethyl butadiene under a low voltage mercury light. The adduct, which was the principal product, is 3,4-dimethyl 7-cyanobicyclo (4,2,2)deca 3,7,9-triene. When this substance is further irradiated with light, or is heated above to above 150 deg, it decomposes into its basic substances (about 50%) and converts to a high boiling point compound. The energy of activation for the thermal decomposition reaction was 34 kcal/mol. Since the effects of adding anthracene, chrysene, phenanthrene, etc., and the fluorescence of benzonitrile are cancelled by the addition of 2,3-dimethyl butadiene, it has been inferred that the role of excited benzonitrile in this reaction is great. Author

N70-41950*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
POLYMERIC VEHICLES AS CARRIERS FOR SULFONIC ACID SALT OF NITROSUBSTITUTED AROMATIC AMINES Patent Application
Paul M. Sawko, inventor (to NASA) Filed 13 Aug. 1970 14 p
(NASA-Case-ARC-10325-1; US-Patent-Appl-SN-63610) Avail: NTIS CSCL 07D

An intumescent agent is provided which contains the ammonium salt of 4-nitroaniline 2-sulfonic acid and a polymer of the mercaptan type which may contain disulfide linkages or

polyoxyalkylene linkages. The adhesion and char resistance of such compositions can be further improved by the addition of epoxy resins. After dispersion and blending of the required components, the compositions are applied to a substrate such as steel or aluminum by spraying or other means to desired thicknesses. The compositions air dry overnight to tough, adherent coatings stable to high humidity environments. These coatings, when exposed to heat or flame, function as intumescent, thermal protection coatings. The coatings intumesce or swell to about 20 to 60 times the original coating thickness, providing a tough, integral, insulating char for protection of substrates from heat or flames. The temperature required to activate the intumescent process occurs at about 300 to 350 C. NASA

N70-41973# National Inst. for Metallurgy, Johannesburg (South Africa). Analytical Chemistry Div.
DETERMINATION OF MOLYBDENUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY
T. W. Steele, J. L. Myburgh, R. C. Mallett, and D. C. G. Pearton 9 May 1969 5 p refs *Its* Lab. Method No. 42/2
(NIM-499) Avail: AEC Depository Libraries

The method was developed for determination of Mo in ores and rocks. The Mo is oxidized with nitric acid and potassium chlorate and then treated with hydrochloric acid. After filtration, the filtrate is diluted to a suitable volume in 2% ammonium chloride and 2% nitric acid. The Mo concentration is calculated by comparison with standard Mo solutions measured in a nitrous oxide and acetylene flame. NSA

N70-41998*# Tracor, Inc., Austin, Tex.
INVESTIGATION OF ADDITIVES FOR IMPROVEMENT OF ADHESIVE AND ELASTOMER PERFORMANCE Final Report
Patrick E. Cassidy, James M. Johnson, and Gary C. Rolls 13 Jul. 1970 167 p refs
(Contract NAS8-24073; Tracor Proj. 074-003)
(NASA-CR-102867; T70-AU-7362-U) Avail: NTIS CSCL 11A

A two-task program was completed which resulted in an evaluation of several coupling agents in adhesive-substrate and elastomer-filler systems. A literature survey which provided a comprehensive background on the various approaches to adhesion promoters was obtained. Nineteen different agents were tested in urethane and epoxy adhesives and in a urethane elastomer. Author

N70-42001# United Kingdom Atomic Energy Authority, Harwell (England). Materials Physics Div.
THE DIDO (6H) LONG WAVELENGTH INELASTIC NEUTRON SPECTROMETER
L. J. Bunce, D. H. C. Harris, and G. C. Stirling Apr. 1970 25 p refs
(AERE-R-6246) Avail: HMSO 4s 6d; BIS $.90

A new long wavelength neutron time-of-flight spectrometer has been constructed, optimized for inelastic neutron scattering studies in chemistry. A cooled beryllium filter is used to select neutrons with wavelengths greater than 4 A from an ambient source in the reactor. Monoenergetic neutron bursts, produced by a pair of phased rotors, are scattered by the sample and detected in a large bank of BF3 counters covering nine different angles. The flight time of the scattered neutrons is measured, and the counts accumulated, in a small on-line computer system. Author (NSA)

N70-42047 National Lending Library for Science and Technology, Boston Spa (England).
THE ANALYSIS OF MIXTURES OF MINERAL ACIDS BY THE ELECTROMETRIC NON-COMPENSATED METHOD [ANALIZ SMESEI MINERALNYKH KISLOT ELEKTROMETRICHESKIM NEKOMPENSATSIONNYM METODOM]
S. K. Chirkov [1970] 10 p ref Transl. into ENGLISH from Zavod. Lab. (USSR), v. 22, no. 9, 1956 p 1041–1044
(NLL-RTS-5884) Avail: Natl. Lending Library, Boston Spa, Engl.: 18s; 3 NLL photocopy coupons

Titration experiments were carried out on sulfuric, nitric, phosphoric and chromic acids, and mixtures of sulfuric and phosphoric and nitric and phosphoric acids. Titration curves are given for all acid reactions. The experiments were carried out in the presence of permanganate. E.H.W.

N70-42091 National Lending Library for Science and Technology, Boston Spa (England).
INTERFERENCE IN THE DETERMINATION OF IRON BY ATOMIC ABSORPTION SPECTROPHOTOMETRY [GENSHI KYUKO BUNKO BUNSEKIHO NI YORU TETSU NO TEIRYO NI OKERU KANSHO]
S. Terashima Jul. 1970 7 p refs Transl. into ENGLISH from Bunseki Kagaku (Tokyo), v. 18, no. 10, 1969 p 1259–1262
(NLL-RTS-5848) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s; 2 NLL photocopy coupons

The interference effects of elements, acids, and salts were studied in the determination of iron by atomic absorption spectrophotometry. Test solutions included silicon, strontium, citric and tartaric acids, aluminum chlorides and sulfates, titanium, manganese chlorides and sulfates, calcium, barium, lanthanum, sodium, potassium, and phosphorus. Reagents and equipment are described as well as measurement conditions, inorganic acid effects, coexistent component effects, and the state of silicon in acidic solutions. The coexistent component interference can be suppressed by allowing the light beam to pass through the upper part of the flame. The interference mechanism is explained by the separative properties of soluble compounds produced in test solutions. J.M.

N70-42101*# South Carolina Univ., Columbia.
INFRARED SPECTRA OF MOLECULES AND MATERIALS OF ASTROPHYSICAL INTEREST Quarterly Progress Report, 15 Jun.–15 Sep. 1970
James R. Durig Sep. 1970 64 p refs
(Grant NGR-41-002-003)
(NASA-CR-114221; QPR-13) Avail: NTIS CSCL 03B

The vibrational spectra from 4000 to 33/cm of several molecules which may be present in the atmosphere of the Jovian planets were studied. The studies were made to provide vibrational frequencies which can be used to: (1) determine the compositions of the cloud covers of several of the planets, (2) provide structural information under favorable circumstances, (3) provide necessary data from which accurate thermodynamic data can be calculated, and (4) furnish information on the nature of the potential energy function of the molecules and forces acting within them. Author

N70-42173# Bureau of Mines, Amarillo, Tex.
AN IMPROVED METHOD AND APPARATUS FOR ANALYSIS OF IMPURITIES IN HELIUM
David E. Emerson, C. A. Hoffman, and G. W. Weems Washington 1970 13 p refs
(BM-RI-7444) Avail: Issuing Activity

An improved method and apparatus for determining the impurities in helium by preconcentration and subsequent analysis by mass spectrometry are described. Preconcentration of the impurities is accomplished by passing a known volume of helium, at slightly above atmospheric pressure, through a metal coil and trap assembly immersed in liquid helium. The concentrated impurities are then analyzed by mass spectrometry. This method can detect impurities in the range of 0.01 to 600 ppm with an accuracy of better than + or – 0.05 ppm at the 1 ppm level. One operator can analyze 15 samples in an 8 hour day. Author

N70-42186# California Univ., Berkeley. Lawrence Radiation Lab.
CORE AND VALENCE ELECTRONIC STATES STUDIED WITH X-RAY PHOTOELECTRON SPECTROSCOPY
Charles Sherwood Fadley (Ph.D. Thesis) Apr. 1970 179 p refs
(Contract W-7405-eng-48)
(UCRL-19535) Avail: NTIS

X-ray photoelectron spectroscopy (XPS) is applied to two separate studies of electronic structure: (1) Experimental and theoretical results are presented for metal-atom electron binding energy splittings due to multiplet effects in the final hole state of the measurement. The 3s electron binding energy is split into two components with a separation as large as 7.0 eV. Theoretical predictions are in good agreement with these 3s results, provided that the effects of covalency in chemical bonding are taken into account. Photoelectron peaks due to the Eu 4d and 4f electrons show certain anomalies in shape and width that are consistent with multiplet splittings. (2) The application of XPS to studies of the valence-band densities of states of solids is discussed. A comparison is made to the closely related experimental technique, ultraviolet photoelectron spectroscopy. XPS results are presented for Fe, Co, Ni, Cu, ZnS, Ru, Rh, Pd, Ag, $CdCl_2$, Os, Ir, Pt, Au, and HgO. A procedure for least-squares fitting of analytic peak shapes to XPS spectra is presented. Also, a technique is developed to correct XPS spectra for the effects of inelastic scattering and a non-monochromatic X-ray source. Author

N70-42198*# Stanford Research Inst., Menlo Park, Calif.
LABORATORY CO_2 PHOTOLYSIS STUDIES RELATED TO PLANETARY ATMOSPHERES Final Report, 15 Jul. 1969 – 15 Jul. 1970
Tom G. Slanger 20 Sep. 1970 38 p refs
(Contract NSR-05-019-252; SRI Proj. PAU-8162)
(NASA-CR-114222) Avail: NTIS CSCL 03B

The work to investigate and solve the problems that have arisen in laboratory studies of CO_2 photolysis in the vacuum uv spectral region, and to apply any new information thus obtained to models of the Martian and Venusian atmospheres is reported. Accomplishments include development of an oxygen resonance radiation source for determining O(P-3) atom concentrations by resonance fluorescence, measurements of primary O(D-1) and secondary O(P-3) quantum yields in CO_2 photolysis, measurements of the rate of the three-body CO_2 recombination reaction, O(P-3) + CO + M yields CO_2 + M, determination of the O(D-1) – CO_2 interaction rate, and the first observations in a new area of spectroscopy involving forced resonance fluorescence processes in certain CO triplet systems. The CO_2 studies indicate that the participation of CO_3 in processes taking place in the planetary atmospheres is unlikely. Author

N70-42207*# National Aeronautics and Space Administration, Washington, D.C.
THE PHOTO-TELOMERIZATION OF ISOPRENE WITH PRENYL BROMIDE AS THE TELOGEN [SHUKAPURENIRU WO TEROGEN TO SURU ISOPUREN NO KOTEROMERUKA]
T. Katagiri et al Oct. 1970 7 p refs Transl. into ENGLISH from Nippon Kagaku Zasshi (Tokyo), v. 90, 1970 p 393 – 394
(NASA-TT-F-13305) Avail: NTIS CSCL 07C

A detailed study was made of the photo-telomerization reaction of isoprene using prenyl bromide as the telogen under ultraviolet irradiation. The reaction products were hydrolized in a 25% lead nitrate-acetone-water system, then separated by gas column chromatography. Their structure was then determined from the infrared absorption spectra and the nuclear magnetic resonance spectra. In addition to photo-telomerization, cation telomerization reactions were brought about with phosphoric acid or zinc chloride and comparative tests were made of the respective reaction products. A 4,2-bonded product, which was not obtained from the other reactions, was found in the telomer ($n = 1$) produced by the photo-telomerization reaction. In addition, a 4,4-bonded product was obtained in large quantities. The mechanics of the photo-telomerization reaction derived from the results is discussed. Author

N70-42222# State Univ. of New York at Buffalo. Dept. of Chemistry.
STUDIES IN SOLUTION AND NUCLEAR CHEMISTRY Progress Report, 1 Oct. 1969 – 30 Sep. 1970
Jacob A. Marinsky 1 Jul. 1970 89 p refs
(Contract AT(30-1)-2269)
(NYO-2269-14) Avail: NTIS

The solution chemistry of alkali metals, alkaline earths, and transition elements was studied in the presence of linear and cross-linked polyelectrolyte models. Various ion-forms of Dowex-50 resin, its polyelectrolyte analog, polystyrene sulfonic acid, polymethacrylic acid, polyacrylic acid, and poly-L-glutamic acid were employed. In addition, ion-exchange selectivity of Linde-A zeolite in mixed media and the physical chemical behavior of alkali metal salts in mixed media were investigated. The study is also directed at elucidating the ion-exchange phenomenon and extending theoretical development of polyelectrolyte models for the interpretation of experimental results. E.M.C.

N70-42249# Boeing Scientific Research Labs., Seattle, Wash.
CHARACTERIZATION OF SILICON SURFACES BY THE ELECTRON ENERGY LOSS SPECTRUM
P. S. P. Wei Jun. 1970 10 p refs
(AD-709325; D1-82-0986) Avail: NTIS CSCL 7/4

The energy loss spectra of silicon during several stages of the cleaning treatment have been studied in a LEED apparatus. A layer of beta-SiC formed on the silicon surface is detected. The results suggest that the energy loss spectrum is sensitive to the change in chemical composition and electronic structure of the solid surface. Author (TAB)

N70-42259# Boeing Scientific Research Labs., Seattle, Wash. Polymer Sciences Lab.
POLYQUINOXALINES CONTAINING FLEXIBILIZING GROUPS IN THE CHAINS
W. Wrasidlo and J. M. Augl (NOL, White Oak, Md.) Jun. 1970 16 p refs Prepared in cooperation with NOL, White Oak, Md.
(AD-709326; D1-82-0981) Avail: NTIS CSCL 7/3

Solution condensations of either 3,3,4,4tetraaminodiphenyl sulfone or 3,3,4,4-tetraaminobenzophenone in combination with various bisbenzils or glyoxals lead to high molecular weight polyquinoxalines. The effect of polymer structure on solubility, glass transition and decomposition temperatures was investigated. Phenylated polyquinoxalines were readily soluble in chlorinated solvents while their structural nonphenylated analogs were insoluble. Polymer decomposition temperatures ranged between 430 and 520C depending upon structure. Polymer films cast from either chloroform or meta-cresol solutions exhibited good toughness and flexibility. Author (TAB)

N70-42263# Picatinny Arsenal, Dover, N.J. Materials Engineering Lab.
PREPARATION OF N SUBSTITUTED POLY(CYCLAMIDES)
J. Richard Hall, Marie C. Ozinger, and Thomas A. Hollingwood Jun. 1970 76 p refs
(AD-709584; PA-TR-3973) Avail: NTIS CSCL 7/3

The preparation of partially N-substituted polyamides based on 1,4-bis(amino-methyl)cyclohexane was investigated with the object of developing a more moisture-resistant nylon-epoxy structural adhesive. The usual method of methoxymethylation of the polymer with formaldehyde and methanol was found to be ineffective. A number of methods of preparing N,N-dialkyl derivatives of cis- and

trans-1,4-bis(amino-methyl)cyclohexane were investigated; the cis- and trans-N,N-dimethyl diamines were successfully prepared by alkylation of the corresponding Schiffs bases, followed by hydrolysis of the intermediate immonium salts. The cis isomer was also prepared by alkylation of the cis-di(benzenesulfonamide), followed by hydrolysis. A number of polymers were prepared, several of which were found to be compatible with epoxy resin in cast films; these could be cross-linked by means of a latent catalyst and heat. Author (TAB)

N70-42269*# Pittsburgh Univ., Pa. Dept. of Chemical and Petroleum Engineering.

THE OZONE OXIDATION OF ETHYLENE AS IT PERTAINS TO AIR POLLUTION

L. K. Peters and L. B. Wingard, Jr. 24 Jul. 1970 35 p refs Supported in part by Natl. Air Pollution Control Admin.

(Grant NGL-30-011-002)

(NASA-CR-114245; SRCC-132) Avail: NTIS CSCL 07D

A review of published data on the kinetic rate constants and the results of an experimental study of ozone decomposition and ozone-ethylene reaction stoichiometry are presented. The review includes data on alkanes, alkenes, alkynes, aromatics, and oxygenated hydrocarbons. The experimental study was made using cylinder ozone dissolved in Freon-13, and involved monitoring the pressure changes that occurred during reaction in a constant volume glass reactor. With this technique, the ozone decomposition rate was much higher than that predicted by published data, apparently from catalytic effects or reactions involving the Freon-13. In the ozone oxidation of ethylene the effect of the initial reactant ratio was significant, and the data indicated that competing reactions were involved. Author

N70-42342# Commissariat a l'Energie Atomique, La Hague (France).

APPLICATION OF ATOMIC ABSORPTION SPECTROPHOTOMETRY TO INDUSTRIAL FABRICATION CONTROLS [APPLICATION DE LA SPECTROPHOTOMETRIE D'ABSORPTION ATOMIQUE AU CONTROLE INDUSTRIEL DE FABRICATION]

Jean Grison May 1970 23 p ref In FRENCH; ENGLISH summary

(CEA-R-3973) Avail: NTIS

Atomic absorption spectrophotometry was used for lowering the costs of analytical process controls. A special installation for evacuating liquid and gaseous effluents made it possible to use the technique both in radioactive and inactive media. It is thus possible to analyse fission product solutions, after dilution, and to determine the impurities present in the uranium solutions. After thorough decontamination, it was also possible to determine impurities in PuO2 and PuF2 by the same technique. Author (ESRO)

N70-42371 National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.

IONIZATION POTENTIALS AND IONIZATION LIMITS DERIVED FROM THE ANALYSES OF OPTICAL SPECTRA

Charlotte E. Moore Sep. 1970 40 p refs

(NSRDS-NBS-34) Avail: SOD $0.75

A current table of ionization potentials expressed in electron volts and a detailed table giving the limits from which they were derived are presented. For each spectrum the ground term is given, with the limit as the ground state. The energy levels of terms of the lowest configuration determined from ground state zero, are also included for selected spectra. The latest recommended conversion factor 0.000123981 corresponding to 1 eV = 8065.73/cm was used throughout. Author

N70-42378 Illinois Univ., Urbana.

NON-EQUILIBRIUM TRANSPORT PROPERTIES OF NITROGEN

Gerald McKee Colver (Ph.D. Thesis) 1969 128 p

Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 70-819

An integral method for determining the transport properties of nonequilibrium partially ionized, partially dissociated nitrogen is given. Experimental measurements of boundary conditions, electron temperatures, and electron densities are used along with the macroscopic equation of flow and equations of species concentrations. Special consideration is given to the differences in electron temperature and gas temperatures. The following transport properties are determined: thermal conductivity, electrical conductivity, and low temperature viscosity. Results show that at the wall the electrical and thermal conductivities of the gas are only about an order of magnitude smaller than those of the ionized gas in the core; but much greater than those of nitrogen at equilibrium composition corresponding to the gas temperature. Dissert. Abstr.

N70-42393 National Lending Library for Science and Technology, Boston Spa (England).

A SIMPLE MEANS OF DETERMINING SULPHATE RADICALS AND SULPHONIC RADICALS BY GAS CHROMATOGRAPHY [GASU KUROMATOGURAFUI NI YORU RYUSANKON OYOBI SURUHON KI NO KAN-I TEIRYOHO]

S. Ito et al Jul. 1970 11 p refs Transl. into ENGLISH from Nippon Kagaku Zasshi (Tokyo), v. 90, no. 10, 1969 p 77–80

(NLL-RTS-5914) Avail: Natl. Lending Library, Boston Spa, Eng.: 20s; 3 NLL photocopy coupons

A predetermined amount of sample liquid was collected in a reaction vessel and after drying and hardening by evaporation, a predetermined amount of the stannic salt of strong phosphoric acid was added as a flux, and a reaction was effected at 300 C for 15 minutes in a tightly sealed cyclic system. The sulfur in the compound was determined by estimating the hydrogen sulfide formed by the reaction, with carbon dioxide as the internal standard. Using sodium sulfate a calibration curve was prepared, and good results were obtained in the determination by this means of various sulfates, inorganic sulfur compounds, and sulfonic acids. This method can be employed for the simple and speedy determination of sulfate radicals and sulfonic radicals. Author

N70-42414# Norges Tekniske Hoegskole, Trondheim.

MELAMINE-FORMALDEHYDE COMPOUNDS. PART 2: THE ACID DECOMPOSITION OF METHYLOL MELAMINES AND METHOXY METHYL MELAMINES

Arvid Berge, Berit Kvaeven, and John Ugelstad 8 Jul. 1969 53 p refs Sponsored by Roy. Norweg. Council for Sci. and Ind. Res.

Avail: NTIS

The acid-catalyzed decomposition of trimethylol melamine (TMM), hexamethylol melamine (HMM), methylated trimethylol melamine (TMM-Me), and hexamethoxy methyl melamine (HMM-Me) were kinetically investigated. The decomposition of TMM and HMM was subject to general acid catalysis. The activation of TMM and HMM arose by addition of a proton to the N-atom in a side group. The more facile protonation of the N-atom in the triazine ring represents a deactivation. The results with HMM indicated that the hexa-substituted melamine compounds are considerably less basic than the less substituted compounds. Author (ESRO)

N70-42474# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering.

A REPORT ON CHEMISTRY AND CHEMICAL ENGINEERING FOR THE ACADEMIC YEAR 1969–1970 Annual Report

Joy Hays, ed. 1970 222 p refs

Avail: Issuing Activity

The research activities in chemistry at the California Institute of Technology are reported. Some of the topics discussed include: (1) quantum theory of atomic and molecular electronic structure, (2) dynamics of interacting systems, (3) photochemistry and radiation

chemistry, (4) organic reaction mechanisms, (5) structure and energy levels by electron impact and optical spectroscopy, (6) air pollution, biomedical engineering, and (7) plasma chemistry engineering. A list of publications during the reporting period is included. F.O.S.

N70-42585# Washington Univ., St. Louis, Mo. Dept. of Physics.
PULSED MAGNETIC RESONANCE AND OTHER STUDIES AT LOW TEMPERATURES Final Technical Report, 1 Jul. 1966–30 Jun. 1970
R. E. Norberg and K. Luszczynski 20 Jul. 1970 12 p
(Contract DA-ARO(D)-31-124-G922)
(AD-710274; AROD-2791-13-P) Avail: NTIS CSCL 7/4

A number of research topics are briefly summarized: A series of experiments on spin diffusion in liquid helium 3-helium 4 mixtures at vapor pressure between 0.4K and 2K with helium 3 molar concentrations between 0.0003 and 0.03; a series of experiments on thermal generation of localized excitations in liquid helium 4 at low temperature; pulsed nuclear magnetic resonance measurements on the solid and liquid phases of neon, krypton and xenon. Author (TAB)

N70-42593# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
MASS SPECTROMETRIC DETERMINATION OF THE CHEMICAL COMPOSITION OF GASES EVOLVED FROM RECONNAISANCE PHOTOGRAPHIC FILM Final Report, Jan.–May 1970
B. Mason Hughes and Thomas O. Tiernan Jun. 1970 18 p
(AD-709880; ARL-70-0091) Avail: NTIS CSCL 14/5

The analytical capabilities of a gas chromatograph-mass spectrometer combination for a variety of materials are described. Modifications made to this instrument for the purpose of increasing analytical versatility and applicability to practical Air Force problems are discussed. As a specific application, the analysis of evolved gases from reconnaisance film samples is considered in detail. Author (TAB)

N70-42602# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
EVALUATION OF MOLECULAR WEIGHT FROM EQUILIBRIUM SEDIMENTATION. PART 3: MOLECULAR WEIGHT DISTRIBUTIONS FROM EQUILIBRIUM SEDIMENTATION-DIFFUSION DATA VIA LINEAR PROGRAMMING Summary Report, Sep. 1968–Aug. 1969
Robert R. Jurick, Donald R. Wiff, and Matatiahu Gehatia May 1970 76 p refs
(AD-709885; AFML-TR-67-121-Pt-3) Avail: NTIS CSCL 7/4

Within the past decade easy access to high speed digital computers has renewed interest in deriving a molecular weight distribution from equilibrium sedimentation-diffusion data. One of the computational schemes which appears most promising is the Simplex Method of linear programming. The purpose of the work was to investigate the advantages and limitations of this approach. It was found that even though inferring a molecular weight distribution from equilibrium sedimentation-diffusion data is mathematically an ill-posed problem, the method of linear programming yields qualitatively a good molecular weight distribution. Also, the method is applicable to the case of one angular velocity. Author (TAB)

N70-42811 National Lending Library for Science and Technology, Boston Spa (England).
POTENTIOMETRIC CONTROL OF HEXAVALENT CHROMIUM CONTENT IN EFFLUENT [POTENTSIOMETRICHESKII KONTROL SODERZHANIYA SHESTIVALENTNOGO KHROMA V STOCHNYKH VODAKH]
P. I. Avrutskii Jul. 1970 8 p refs Transl. into ENGLISH from Vodosnabzh. Kanaliz. Gidrotekh. Sooruzheniya (USSR), no. 9, 1969 p 82–88
(NLL-RTS-5947) Avail: Natl. Lending Library, Boston Spa, Engl.; 14s; 2 NLL photocopy coupons

A method for determining the change of hexavalent to trivalent chromium by measuring the oxidation reduction potential is described. The effects of the medium pH, concentration of admixtures in the effluent, temperature, and initial concentration of hexavalent chromium are investigated. The most important factor affecting the emf measurements is considered to be the presence of iron ions. A platinum/glass or gold/glass electrode system is recommended. N.E.N.

N70-42619# California Inst. of Tech., Pasadena.
STUDIES IN CHEMICAL DYNAMICS AND RADIATION CHEMISTRY Technical Progress Report, 1 Jul. 1969–30 Jun. 1970
Aron Kuppermann 30 Jun. 1970 28 p refs
(Contract AT(04-3)-767)
(CALT-767-P-4-63) Avail: NTIS

Progress is reported on low-energy electron scattering, photoelectron spectrometry, elementary reactions by photolysis at various wavelengths, collisions in crossed molecular beams, theory of chemical reactions, and diffusion kinetics in radiation chemistry. NSA

N70-42624# Rocketdyne, Canoga Park, Calif.
HYBRIDIZATION FROM VIBRATIONAL FORCE CONSTANTS Final Report, 1 May 1966–30 Apr. 1970
E. C. Curtis 30 Apr. 1970 20 p refs
(Contract AF 49(638)-1734)
(AD-710281; R-8247; AFOSR-70-1871TR) Avail: NTIS CSCL 7/4

A summary is given on force constant computations on some small inorganic molecules. The molecules considered were selected largely from the interhalogens, the noble gas compounds and some related molecules. When possible, the numerical force constants were analyzed in terms of models related to the type of molecular bonds. A method was developed to permit analysis of underdetermined systems in a statistically sound fashion. While this does not permit a unique solution, it conveniently raquires that force constants for similar molecules be transferable and provides an uncertainty estimate. This method was appropriate for a number of the cases considered. Author (TAB)

N70-42777* # Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.
VACUUM IGNITION CHARACTERISTICS OF OXYGEN DIFLUORIDE/DIBORANE AND FLOX/DIBORANE Final Report, 15 Jan.–14 Dec. 1969
T. F. Seamans Feb. 1970 100 p refs Prepared for JPL
(Contract NAS7-660)
(NASA-CR-110878; RMD-5536-F) Avail: NTIS CSCL 21B

The vacuum ignition characteristics of OF2/B2H6, primarily, and Flox/B2H6 were investigated in 100 lbf thrust rocket engines to determine potential problem areas and define design concepts required to insure reliable vacuum starting of space engines. The engine and operating parameters investigated were design chamber pressure, dribble volume/injector configuration, propellant valve type, valve/injector coupling, run tank ullage, propellant lead/lag, oxidizer temperature, fuel temperature and hardware temperature. Ignition spikes occurred with the OF2/B2H6 combination but only under conditions of an oxidizer lead. No ignition spikes were observed under any conditions with the FLOX/B2H6 combination. Cocking of the solenoid valve poppets just prior to the start of normal poppet transfer allows a low preflow of the propellants into the chamber. Initial ignition is very fast and occurs in the vapor phase when one or both of the propellants is in the pre-flow

period. Propellant concentrations, and temperature, are very low. The initial ignition produces a weak flame that acts as a pilot flame for the oncoming bulk flows. Author

N70-42778 Oklahoma Univ., Norman.
VOLUMETRIC BEHAVIOR OF THE HELIUM-ARGON SYSTEM AT HIGH PRESSURE AND LOW TEMPERATURE WITH A PERTURBATION EQUATION OF STATE FOR METHANE
Joseph Allan Provine, Jr. (Ph.D. Thesis) 1969 236 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.05 Order No. 69-18460

A Burnett apparatus was used to obtain the experimental data for the helium-argon system. The results are reported for the two pure components and four mixtures for three isotherms ranging from 143 to 183 K. The method of treating the data to obtain the optimum virial coefficients and compressibility factors uses an orthonormal polynomial, nonlinear curve fitting technique to obtain initial estimates of the apparatus constants and virial coefficients. A Newton–Raphson procedure is then used to converge to the optimum set of parameters based on a defined best fit criterion. The compressibility factors are calculated at each experimental pressure from the optimum virial coefficients using the Leiden form of the virial expansion. Estimates of the standard errors in the parameters and in the data are also determined. A perturbation equation of state for methane is proposed that is based on theoretical results until the functional form of the cutoff parameter is determined. Dissert. Abstr.

N70-42788# Utrecht State Univ. (Netherlands). Organic Chemistry Lab.
A METHOD FOR THE SEPARATION OF PEPTIDES FROM ALPHA-AMINO ACIDS [EEN METHODE VOOR DE SCHEIDING VAN PEPTIDEN VAN ALPHA-AMINOZUREN]
Dirk Krijn Johannes Tommel (Ph.D. Thesis) Oct. 1969 54 p refs In DUTCH; ENGLISH summary Sponsored in part by Neth. Organ. for Pure Sci. Res. and Unilever N.V.
Avail: NTIS

A new method for the separation of peptides from alpha-amino acids, based on the fact that at pH = 8.0 the cupric chelates of the neutral and basic amino acids are neutral or positively charged, is described. The peptide-cupric complexes, however, are then negatively charged, as are the complexes of aspartic acid and glutamic acid. In anion exchange chromatography the peptide chelates are retarded, contrary to the amino acid chelates (except those of the acidic amino acids). Examples of several applications are given including plasmolysis. ESRO

N70-42791# State Univ. of New York at Buffalo. Dept. of Chemistry.
ION EXCHANGE SELECTIVITY OF THE SYNTHETIC ZEOLITE LINDE A IN ANHYDROUS AND MIXED MEDIA
R. B. Barrett and J. A. Marinsky [1970] 27 p refs
(Contract AT(30-1)-2269)
(TID-25452) Avail: NTIS

The selectivity coefficients for the ion exchange of cesium with sodium A-zeolite and cesium and sodium with potassium A-zeolite were determined in nonaqueous and mixed media. The exchanging ions were at radioactive tracer level concentrations so that the fraction of the micro-ion of the zeolite was essentially unity in both the zeolite and external liquid phase. The dramatic increase in ion-selectivity at very high alcoholic content of the liquid phase could not be qualitatively examined and was attributed to the significant solvation of the zeolite by the alcohol in the alcohol-rich media. The special properties of the zeolite, rigidity, resistance to electrolyte incursion and high selectivity for water were believed to permit recourse to this model in mixed media over an alcohol–water weight percent composition ranging from 0 to 70. Correlation of experimental and calculated selectivity points was sufficiently good to support the validity of this approach. Author (NSA)

N70-42799# Michigan State Univ., East Lansing. Dept. of Chemistry.
THE INCONGRUENT VAPORIZATION OF NONSTOICHIOMETRIC YbC(1.25 + y)
John M. Haschke and Harry A. Eick [1970] 13 p refs
(Contract AT(11-1)-718)
(COO-716-58) Avail: NTIS

The vapor pressure of gaseous ytterbium in equilibrium with YbC(1.25 + y)(S) ($0.12 < y < 0.16$) and YbC(2)(S) was measured by a target collection Knudsen effusion technique over the temperature range 1056 to 1337 K. Third law enthalpies of vaporization and enthalpies of formation are discussed. Author (NSA)

N70-42819# Rutgers Univ., New Brunswick, N.J. School of Chemistry.
ON THE CURRENT STATUS OF MOSSBAUER SPECTROSCOPY STANDARDS
Rolfe H. Herber [1970] 15 p refs Sponsored in part by AEC
(NYO-2472-67) Avail: NTIS

The present status of velocity calibration standards for Mossbauer spectrometers is discussed, including such methods as measuring the magnetic hyperfine spectrum of metallic iron, the frequency modulation of the motion of the Moessbauer source, and cosine smearing for determining line positions at large Doppler velocities. Also, isomer shift standards are discussed including iron-57, tin-119, iodine-129, and others. NSA

N70-42919# Iowa State Univ. of Science and Technology, Ames.
STABILITY CONSTANTS OF SOME CARBOXYLATE COMPLEXES OF THE TRIVALENT LANTHANONS
Christopher Duncan Devine (Ph.D. Thesis) 1969 183 p refs
(Contract W-7405-eng-82)
(IS-T-381) Avail: NTIS

The stoichiometric stability constants of the complexes formed by the trivalent rare earth ions with the 2,2-bis (hydroxymethyl) -propionate and alpha - hydroxyisobutyrate anions were measured at 25 deg and an ionic strength of 0.1000 M using NaClO4 as a supporting electrolyte. The method of competing reactions was used for the study, and twenty sample solutions were prepared for each metalligand system studied. The pH of each sample was measured with a Beckman model 1019 pH meter. The stability constants were calculated by means of a weighted least squares program using an IBM-360 computer. A variable acid dissociation constant was used in the calculations. The relation between the stability constants and rare earth ionic radius was found to be remarkably different for each of the ligands studied. In order to account for this fact and for other features of the data, a theory of rare earth complex formation was proposed. It is suggested that the trends in the stability of the rare earth 2,2-bis(hydroxymethyl)propionate complexes primarily reflected the varying degrees of hydration of the rare earth ions. Author (NSA)

N70-42935# Missouri Univ., Columbia.
THE EFFECT OF SALTS ON THE DERIVATIZATION AND CHROMATOGRAPHY OF AMINO ACIDS
Charles W. Gehrke and Kenneth Leimer [1969] 12 p refs
(Grants NGR-26-004-011; NSF GB-7182)
(NASA-CR-110880) Avail: NTIS CSCL 07D

A study was undertaken to investigate the effects of cations and anions on the derivatization and chromatography of 17 protein

amino acids as the N-TFA n-butyl esters. A gas chromatograph with a four-column oven bath, four flame ionization detectors, two dual differential electrometers, and equipped with a dual pen recorder was used for the study. A digital readout integrator was used for determining peak areas. For the chromatography and quantitative analysis of the samples, 5.0 microliters of the derivatized sample were injected. The first injection was a standard followed by a salt containing sample; then the standard was reinjected. The same concentration of each amino acid and internal standard was used in all experiments, and the same known volume was injected each time into the chromatography column. It was then possible to determine whether the experimental areas for the amino acids, or internal standard was enhanced or reduced by the added salt. The results are given in tabular form and a discussion of their significance is included. D.L.G.

N70-42962# Battelle Memorial Inst., Columbus, Ohio.
FAR INFRARED STUDIES OF THE HYDROGEN BOND Final Report, 1 May 1965 - 31 Oct. 1969
Robert J. Jakobsen, J. W. Brasch, Y. Mikawa, and P. E. Strup 27 Jul. 1970 8 p refs
(Grants AF-AFOSR-911-65; AF-AFOSR-1621-69; AF-AFOSR-911-67)
(AD-710135; AFOSR-70-2112TR) Avail: NTIS CSCL 7/4

A brief summary is given of work involving the far infrared spectra of hydrogen bonded acids and alcohols. The hydrogen bond vibrations of these compounds were assigned. In many instances these assignments were used to deduce the hydrogen bond structure of the particular compound involved. Author (TAB)

N70-43032# Utrecht State Univ. (Netherlands). Organic Chemistry Lab.
REACTIONS OF ORGANOTIN HALIDES WITH ZINC: THE OCCURRENCE OF 1,2-INTERMETALLIC SHIFTS
Francois John Adriaan des Tombe (Ph.D. Thesis) Nov. 1969 63 p refs Partly in DUTCH and partly in ENGLISH
Avail: NTIS

The reactions of organic tin halides with zinc are investigated in detail. The synthesis, reactions and some spectral properties of triphenyl stannyl zinc compounds are first described and then the reactions of organic tin halides with zinc or zinc-copper couples are discussed. Experimental procedures are described in detail. ESRO

N70-43074*# Maryland Univ., College Park.
GASEOUS DIFFUSION COEFFICIENTS. A COMPREHENSIVE CRITICAL EVALUATION OF EXPERIMENTAL STUDIES AND CORRELATIONS OF RESULTS
Thomas Raphael Marrero (Ph.D. Thesis) 1970 437 p refs
(Grant NGR-21-002-053)
(NASA-CR-110785) Avail: NTIS CSCL 07D

Diffusion coefficients of binary mixtures of dilute gases are comprehensively compiled, critically evaluated, and correlated by new semiempirical expressions. A detailed analysis of experimental methods is given, and intercomparison of their results helps establish reliability limits for the data, which depend strongly on temperature. Direct measurements are supplemented by calculations based on knowledge of intermolecular forces derived from independent sources: molecular beam scattering for high temperatures, and London dispersion constants for low temperatures. In addition, diffusion coefficients for several mixtures are obtained from experimental data on mixture viscosities and thermal diffusion factors. Combination of all these results gives diffusion coefficients over a very extensive temperature range, from very low temperatures to 10,000 K. All data are corrected for composition dependence and for quantum effects. The correlated diffusion data are used to develop a corresponding-states procedure for predicting diffusion coefficients on the basis of fragmentary information. Author

N70-43122*# Missouri Univ., Columbia.
TRIMETHYLSILYLATION OF AMINO ACIDS. EFFECT OF SOLVENTS ON DERIVATIZATION USING BSTFA
Charles W. Gehrke and Kenneth Leimer [1970] 16 p refs
(Grants NGR-26-004-011; NSF GB-7182)
(NASA-CR-110884) Avail: NTIS CSCL 07D

The number of chromatographic peaks for the TMS derivatives of glycine and arginine are determined by the polarity of the solvent. With hexane, methylene chloride, chloroform, and 1,2-dichloroethane, one peak is obtained for glycine and two peaks are obtained in six other more polar solvents. Arginine gives no peak in the four less polar solvents studied and one peak in the other six more polar solvents. Preliminary work is reported on chromatography using a 6 m by 2 mm i.d. glass column of 10 w/w% OV-11 on 100/120 mesh Supelcoport, of which good resolution was obtained for the TMS derivatives of 19 of the protein amino acids. Author

N70-43123*# Missouri Univ., Columbia.
THE HYDROLYSIS OF PROTEINS
Don Roach and Charles W. Gehrke [1969] 29 p refs Sponsored in part by Dept. of Agr. /ts J. Ser. No. 5993
(Grants NGR-26-004-011; NSF GB-7182)
(NASA-CR-110881) Avail: NTIS CSCL 06A

The rates and yields of protein hydrolysis were studied and the optimum reaction conditions were determined for obtaining maximum yields of all 20 of the protein amino acids in the shortest possible time, using ribonuclease as a representative protein. The effect of temperature on the hydrolysis reaction in aqueous 6NHCl was investigated to develop a rapid hydrolysis procedure. Recovery studies as a function of hydrolysis time at 145 C were made using standard amino acid mixtures and almost complete recovery was obtained on hydrolyzing for 2 to 4 hours. Author

N70-43151# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ADSORPTION ON PLUTONIUM. PART 2: THE LIGHT-WEIGHT HYDROCARBONS
Larry E. Musgrave and Anthony Di Giallonardo 25 May 1970 9 p refs
(Contract AT(29-1)-1106)
(RFP-1457-Pt-2) Avail: NTIS

The sticking probability and surface coverage of methane, ethylene, and ethane molecules impinging on evaporated plutonium films were measured. The sticking probability showed a rapid decrease from 0.2 to a nearly constant value of 0.01, until full coverage, when a rather rapid decrease occurred. The coverage varied from 14.5 × 10 to the 14th power molecules per square centimeter for methane, 8.8 × 10 to the 14th power molecules per square centimeter for ethylene, and 11.0 × 10 to the 14th power molecules per square centimeter for ethane. Possible bonding mechanisms are discussed. Author (NSA)

N70-43158# Atomic Power Development Associates, Inc., Detroit, Mich.
SOLUBILITY OF HYDROGEN IN SODIUM
S. A. Meacham (Westinghouse Elec. Corp.), E. P. Hill (Varian Assoc.), and A. A. Gordus (Mich. Univ., Ann Arbor) Jun. 1970 58 p refs
(Contract AT(11-1)-865)
(APDA-241) Avail: NTIS

The solubility of hydrogen in liquid sodium was determined using a closed-cell technique that was found to be superior to previous methods. The variables studied were hydrogen pressure, temperature, and the oxygen content of the sodium. Plots of P(1/2) of hydrogen versus parts per million of hydrogen dissolved in sodium were linear at pressures above 0.1 Hg, the slopes being equal to approximately 14.8 ppm dissolved hydrogen ×(P sub cm Hg)(- 1/2). An additional phase (NaH solid solution) can be formed at each temperature resulting in an invariant system. The

temperature dependencies of the hydorgen pressure and the hydrogen solubility of these saturated solutions were almost identical for sodium solutions containing 7 and 25 ppm dissolved oxygen and are described by given equations. Author (NSA)

N70-43184# California Univ., Livermore. Lawrence Radiation Lab.
INVESTIGATIONS AT HIGH TEMPERATURES: CONDENSED-PHASE EQUILIBRIA AND VAPORIZATION STUDIES WITH A MASS SPECTROMETER
Ray G. Bedford (Ph.D. Thesis) Jun. 1970 113 p refs Sponsored by AEC
(UCRL-50886) Avail: NTIS

The Eu−Eu2O3 system was studied in detail, with the compositions and melting points of the stable phases being determined. Equilibria between the europium oxides and the Eu−Pt system were investigated at 1500 C, and the Sm−Sm2O3 and Yb−Yb2O3 systems were also studied. Ternary equilibria in the Eu−O−F and Sm−O−F systems were studied up to 1500 C for Eu(2+)−Eu(3+) and Sm(+3). A mass spectrometric investigation was carried out on the sublimation of Hf from a dilute alloy with Zr as a reference. The vaporization kinetics of GaN and the composition of the vapor species were studied. NSA

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N70-41873# Army Foreign Science and Technology Center, Washington, D.C.
EFFECT OF REFLECTIONS OFF THE ENDS OF A WAVEGUIDE UPON THE POLARIZATION PATTERN OF A SLOTTED WAVE-GUIDE EMITTER WITH CONTROLLED POLARIZATION
Yu. V. Shubaryan et al 14 Jan. 1970 9 p ref Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radkotekhn. (Kiev), v. 11, no. 6, 1968 p 643−646
(AD-708836; FSTC-HT-23-262-70) Avail: NTIS CSCL 20/14

The report shows that is is possible to control polarization of the field in a plane perpendicular to the axis of the waveguide as well as in the presence of reflections from the ends of the waveguide for the cases of both single slit, and an array of slits. Author (TAB)

N70-41881*# Electrac, Inc., Anaheim, Calif.
A DESIGN STUDY FOR AN OPTIMAL NON-LINEAR RECEIVER/DEMODULATOR Final Report
A. J. Mallinckrodt, R. S. Bucy, and S. Y. Cheng 31 Aug. 1970 131 p refs
(Contract NAS5-10789)
(NASA-CR-114111) Avail: NTIS CSCL 09E

A cyclic phase nonlinear filtering technique was developed for use with modular phase tracking systems, and implementation based on the Fourier series representation of the cyclic density function was derived. First-order phase processes for faster computation in digital simulations and for results available in Weiner optimum phase lock loop for comparison purposes are described. However, the technique is equally applicable to higher-order systems. The performance of the nonlinear filter was investigated using Monte Carlo techniques, and the classical phase lock loop was simulated as a reference for the nonlinear process. E.M.C.

N70-41894# Geotronics, Inc., Falls Church, Va.
FIN ANIMAL ANTENNA Final Report
Jul. 1970 104 p ref
(Contract NAS5-11689)
(NASA-CR-114122) Avail: NTIS CSCL 09E

A fin antenna was developed to operate with the IRLS system to provide optimum patterns for animal packages when interrogated from a satellite. The antenna has a pattern which maximizes the energy radiated near zenith. The antenna is circularly polarized. One of the primary characteristics of the antenna is its rugged, low-profile mechanical design. The work performed during the antenna development is described. The results obtained are close to or exceed the design goal in all respects. The characteristics of the final model are described. Author

N70-41942*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE L-BAND AIR-TRAFFIC CONTROL SATELLITE SIMULATION EXPERIMENT USING BALLOONS
Jayaram Ramasastry Jul. 1970 54 p refs
(NASA-TM-X-65348; X-551-70-306) Avail: NTIS CSCL 09E

High altitude balloons are used to simulate satellite experiments to obtain data concerning signal multipath, RF noise background, antenna gain factors, and L-band system performance. The data obtained will be used in the design of a preoperational satellite system for air traffic control. The balloon experiment will also satisfy the need for data that cannot be obtained by a satellite experiment. Author

N70-41978*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRAFFIC CONTROL SYSTEM AND METHOD Patent Application
Charles R. Laughlin, Roger C. Hollenbaugh, and Walter K. Allen, inventors (to NASA) Filed 18 Jun. 1970 11 p
(NASA-Case-GSC-10087-4; US-Patent-Appl-SN-47440) Avail: NTIS CSCL 17B

A system and method are disclosed for positioning and deriving centralized air traffic control data for communicating via voice and digital signals between a multiplicity of remote aircraft including supersonic transports and a central station, as well as a peripheral ground station (or stations), through a synchronous satellite relay station. Side tone ranging patterns, as well as the digital and voice signals, are modulated on a carrier transmitted from the central station and received on all of the supersonic transports. Each aircraft communicates with the ground stations via a different frequency multiplexed spectrum. Supersonic transport position is derived from a computer at the central station and supplied to a local air traffic controller. Position is determined in response to variable phase information imposed on the side tones at the aircraft, with a plurality of different side tone techniques being employed, and relayed back to the transports. Common to all of the side tone techniques is Doppler compensation for the supersonic transport velocity. NASA

N70-42022*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A REAL-TIME DATA COMPRESSION SYSTEM FOR APOLLO PCM TELEMETRY
A. George Carlton, Harry D. Zink, Robert L. Appel, and Gary P. Gafke Dec. 1969 184 p
(NASA Order S-70130-G; Contract NOw-62-0604-c)
(NASA-CR-114106; AD-707333; APL-TG-1093) Avail: NTIS CSCL 09B

The compression could be applied to the data transmission on the link between the Manned Space Flight Network sites and Goddard Space Flight Center to give a savings in realized telephone cable capacity and to transmit more information to Mission Control. The method of data transmission permits all the data in the 51.2

kbps bit stream from the command service module or the lunar module to be sent in real time over two 2.4-kbps voice-data-quality telephone lines. Very basically, the system uses a zero order predictor with a variable window to screen out redundant data; run length encoding is used to encode the location sequence, and 2-9 encoding is used to encode the data values. Combining these two coding schemes results in 88 bits per frame, on the average. This technique requires modification of the present computer software only; it does not require any hardware changes. Author

N70-42038# Institute for Telecommunication Sciences, Boulder, Colo.
AN ANALYSIS OF THE SHUNT-FED LOG-PERIODIC MONOPOLE ARRAY ANTENNA
Pitt Willis Arnold Mar. 1970 67 p refs
(ESSA-TR-ERL-161-ITS 103) Avail: SOD $0.65

An anayltic method is introduced enabling one to insert the physical dimensions of a shunt fed log periodic monopole array antenna into a properly arranged computer program and obtain reasonably accurate information about the radiation and impedance characteristics of the antenna from the resultant computer output. The method is related to a similar analysis of dipole type antennas but the complexity of the feed system of the shunt fed structures causes the matrix relations to be more complex than those of the dipole antenna. Computed and experimental results are compared and the optimized feed case is discussed at some length. Author

N70-42048*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE ALTIMETRY
John W. Bryan Jun. 1970 38 p refs Submitted for publication
(NASA-TM-X-65347; X-551-70-248) Avail: NTIS CSCL 17I

A review is presented of the basic satellite radar altimeter requirements for the study of topography, sea condition and orbit determination. Methods of implementing these basic requirements for various types of topography are included. State-of-the-art techniques are also included along with some technological considerations which may require space application development programs. Author

N70-42082# Stanford Univ., Calif. Stanford Electronics Labs.
THE STANFORD METEOR-TRAILS RADAR MARK 2 Final Report, 1 Mar. 1967 - 31 Dec. 1969
Robert Nowak, Edgar M. North, and Michael S. Frankel Jun. 1970 185 p refs
(Contract AF 19(628)-6152)
(AD-709673; SU-SEL-70-021; AFCRL-70-0365) Avail: NTIS CSCL 17/9

In the study of upper-atmosphere winds and densities, radar measurements of the ionized trails of meteors in the height region between 80 and 110 km have proven valuable. In the present report, this measurement technique is compared to other methods and its advantages and problems are outlined. Considerations for the design of a meteor-trail radar system are presented. The desire for a global network of meteor-trail radar stations, which would aid significantly in the study of synoptic atmospheric patterns, calls for a reliable, simple, and inexpensive design. Such a design, realized at Stanford University and tested in operation, is described in detail. Data are recorded automatically on digital magnetic tape and are reduced completely by computer; except for tape changes, the station operates unattended. Circuit diagrams, assembly, and tuning procedures for the complete station are presented, and the computer program used for data reduction is listed. The equipment was built on printed circuit cards for which negatives are available, on request, from Stanford University. Author (TAB)

N70-42162*# Virginia Univ., Charlottesville.
ACTIVE MICROWAVE IRISES AND WINDOWS Patent Application
Robert L. Ramey, Hugh S. Landes, and Eugene A. Manus, inventors (to NASA) Filed 18 Aug. 1970 10 p Sponsored by NASA
(NASA-Case-LAR-10513-1; US-Patent-Appl-SN-64723) Avail: NTIS CSCL 17B

A waveguide thin film window or an iris is fabricated from either a thin film or a conventional plate, mounted transverse to the flow of energy in a waveguide, and electrically insulated from the waveguide. Diode switching means are provided for selectively disconnecting and connecting the window or iris to the walls of the waveguide. NASA

N70-42200*# Stanford Univ., Calif. Radioscience Lab.
A VHF POLARIMETER
William E. Faulkerson Jun. 1970 78 p ref
(Grant NGL-05-020-014)
(NASA-CR-114214; SU-SEL-70-035; TR-35) Avail: NTIS CSCL 09E

The design of a polarimeter for obtaining a continuous record of ionospheric electron content over a fixed raypath by measuring the Faraday rotation of linearly polarized VHF transmissions from geostationary satellites is presented. A polarimeter system is described, which consists of a rotating antenna and a receiver/phase-meter instrument that can be economically constructed to perform this measurement. Details of construction, alignment, and operation are discussed. Author

N70-42213# Brown Univ., Providence, R.I. Div. of Applied Mathematics.
CHIMERAS
Frederic Bisshopp May 1970 39 p refs
(Contract Nonr-562(42))
(AD-709431; TR-12) Avail: NTIS CSCL 12/1

The propagation of nonlinear wave packets and modulated beams, and other features of nonlinear wave propagation can be described in terms of several approximate, heuristic theories. The neoclassical approximation, to be presented here, is representative of a style of approximation that includes a number of the approximations currently in use as special cases or as limiting cases. It is, in a manner of speaking, the best approximation of its kind in the sense that it coincides with the nonlinear wave equation from which it is derived in more limiting cases than any of the others, and though it too is heuristic, it is rational, being the first of a sequence of approximations that converges to a solution if it converges. Chimeras are the solutions of the equations of the neoclassical approximation; there are a number of exact ones, to be exhibited here, that describe phase-shocks, self-focused beams, and localized wave packets that travel, without change of shape, at an arbitrary uniform velocity less than one. Author (TAB)

N70-42216# General Instrument Corp., Hicksville, N.Y. Electronic Systems Div.
RADAR SET AN/PPS-17 (FAILURE FREE DEVELOPMENT PROGRAM) Interim Development Report, 1-30 Jun. 1970
Walter Seidman and Al Zecca 30 Jun. 1970 38 p
(Contract N00039-70-C-3501)
(AD-710002; ESD-1157-IR-5) Avail: NTIS CSCL 17/9

The report covers the Phase 2 portion of the program to design, manufacture and test 20 high reliability radar; AN/PPS-17 (XN-1). The report covers the period during which re-evaluation of system parameters on radar performance and testing of Gunn diode transmitters is being completed. Breadboard system integration and testing is continuing. Author (TAB)

N70-42254# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DESIGN OF STABLE, HIGH EFFICIENCY, HIGH POWER UPPER SIDEBAND UPCONVERTERS
Raymond L. Sicotte 17 Jun. 1970 55 p refs
(Contract AF 19(628)-5167)
(AD-709362; TN-1970-10; ESD-TR-70-180) Avail: NTIS CSCL 9/1

This report presents a logical design procedure to build stable, efficient varactor upper sideband upconverters. It establishes general design criteria to provide unconditional stability, low spurious, predictable diode impedance levels, and predictable efficiency. A sample design is included to illustrate one means of realizing the design constraints and showing the agreement between predicted and achieved stability, impedance match, efficiency, and power output. The second part of the report discusses means of obtaining high power operation by using multiple varactors. It is concluded that the best configuration is a series stack of varactor diodes. With allowance made for the package parasitic reactances, it is proven analytically that stacked, packaged diodes operate efficiently as an upper sideband upconverter. Finally, an example of a stacked varactor upconverter design was built and measured. The agreement between predicted and obtained results is remarkably good. Author (TAB)

N70-42323 Northwestern Univ., Evanston, Ill.
SCATTERING BY CYLINDERS AT HIGH FREQUENCIES
George Michael Mavrides (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 70-115

The scattering of monochromatic waves by a circular cylinder is studied, subject to the impedance boundary condition differential n F = ZF. Expressions for various field quantities are derived by the systematic use of the theory of Green's functions and spectral representations. The usefulness at high frequencies of these results is examined with the use of the properties of Bessel functions and their zeros as functions of their order. New asymptotic power series representations for the scattering cross section are obtained for any value of the impedance. These new representations are simple and revealing as to the role of the impedance, while their accuracy is found to be excellent. Dissert. Abstr.

N70-42327* # Polytechnic Inst. of Brooklyn, N.Y. Dept. of Electrical Engineering.
DIGITAL COMMUNICATIONS TECHNIQUES Interim Report, Feb.–Jun. 1970
Raymond L. Pickholtz 1970 31 p
(Grant NGR-33-006-020)
(NASA-CR-114123; PIBEE-70-003; IR-2; IR-3) Avail: NTIS CSCL 17B

Four digital communications techniques tasks are discussed: (1) a coding technique for a time dispersive channel; (2) applications of recursive techniques in adaptive array processing; (3) a decoding algorithm for truncated convolutional codes; (4) equalization of partial response channels. E.C.

N70-42358# Royal Aircraft Establishment, Farnborough (England).
DESIGN DATA FOR ACTIVE TRANSITIONAL BUTTERWORTH-THOMSON FILTERS
W. J. Norman Mar. 1970 27 p refs
(RAE-TR-70050) Copyright. Avail: NTIS

Tables and graphs are given for the rapid calculation of the elements of an active low-pass transitional Butterworth-Thomson filter. This class of filter, having steady state and transient characteristics intermediate between those of the Bessel and Butterworth types, enables an effective compromise to be reached between a high rate of cut-off and an acceptable amount of ringing. The Sallen and Key circuit is used and figures are given for filters up to the tenth order. The design of a pre-sampling filter, used to minimise aliasing in a time-multiplexed telemetry system, is discussed. Author (ESRO)

N70-42377 Missouri Univ., Rolla.
SIGNAL DISTORTION IN A REGENERATIVE FREQUENCY DIVIDER
Carl Ray Ryan (Ph.D. Thesis) 1969 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-19431

A regenerative frequency divider can be constructed with one integrated circuit and a single-pole tuned circuit. The divider can be used as a means for reducing the modulation index of either deterministic or random signals. This reduction in modulation index can simplify many signal processing schemes. This technique can be used up to S-band frequencies. Dissert. Abstr.

N70-42418 Missouri Univ., Rolla.
SPHERICAL ANTENNA ARRAY
Narong Yoothanom (Ph.D. Thesis) 1969 165 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-19436

The far field radiation pattern of an isotropic spherical antenna array with two types of element distributions, a latitude-longitude distribution and an approximately equally-spaced distribution, was analyzed using Poisson's sum formula. Beamwidth expressions of both element distributions are found in various planes. All numerical results are given only for the case of 21 rings. Dissert. Abstr.

N70-42468 Northwestern Univ., Evanston, Ill.
ELECTROMAGNETIC WAVE SCATTERING BY DIELECTRIC SPHERES
Hitoshi Inada (Ph.D. Thesis) 1969 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-78

An analysis is presented for calculating the backscattered fields of an electromagnetic plane wave by lossless dielectric spheres of arbitrary density. This method involves the Watson transformation which serves to split the exact Mie solution, given as an infinite series, into the geometrical optics fields and the diffracted fields. The optics fields are derived and it is shown that they differ in some respects from those obtained by the geometrical optics method. The diffracted fields which give rise to surface waves are covered. The derivation and calculations of the surface wave fields are discussed in detail. Based on the results a physical model of the scattering mechanism for surface waves is constructed. The diffracted fields (surface waves) are the major contributors to the total backscatter in the range of ka (5 to 20). The small ripples and large period in the curves of the backscattering cross sections of the surface waves are explained. Dissert. Abstr.

N70-42480 Polytechnic Inst. of Brooklyn, N.Y.
BINARY PHASE-SHIFT KEYED COMMUNICATION SYSTEMS
James Francis Oberst (Ph.D. Thesis) 1969 307 p
Avail: Univ. Microfilms: HC $13.95/Microfilm $3.95 Order No. 69-17797

The necessary phase estimation is accomplished either by transmitting a separate reference signal to be tracked at the receiver or by special nonlinear processing of the keyed signal itself at the receiver. The models and assumptions employed are maintained uniform, so that valid comparisons can be made among the various systems. Analytical and Monte Carlo simulation results are presented for several differentially encoded single channel PSK systems. In addition, a simple technique for computing the probability of double errors in differential PSK is presented. A simple but accurate model of single channel PSK systems is developed for studying the efficiency of various data encoding schemes in overcoming the problem of mark-space ambiguity. Some attention is also given to systems which employ the phase locked loop to establish carrier synchronization. The relationships among several seemingly different systems are developed. The choice of the nonlinearity in harmonic tracking type systems is examined analytically. Dissert. Abstr.

N70-42508 Carnegie-Mellon Univ., Pittsburgh, Pa.
DESIGN AND SYNTHESIS OF SIGNALS UTILIZING A MAGNITUDE RESPONSE CRITERION AND TIME-FREQUENCY SHIFTED BASIS
James Waldron Sennott (Ph.D. Thesis) 1969 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-19108

The problem of signal/processor design and synthesis for detection and estimation of signal returns which are perturbed by concentrations of delayed and frequency shifted signal reflections plus white noise are discussed. The approach chosen is that of signal synthesis under matched filtering. The criterion for synthesis is the weighted least-square error of magnitude matched filter response over the signal return parameter plane. Response in this plane may be translated into detection and parameter estimation performance in the dense signal return environment.
Dissert. Abstr.

N70-42515# Harry Diamond Labs., Washington, D.C.
AN ADDITIVE NOISE MEASUREMENT EQUIPMENT FOR PRODUCTION LINE USE
Walter F. Straub Jun. 1970 29 p refs
(AD-710219; HDL-TM-70-10) Avail: NTIS CSCL 17/9

It is often desirable to evaluate the additive noise performance of the microwave amplifier of a radar system during the production phase. This report describes equipment that measures the FM noise components from 300 Hz to 3 kHz which have been added to the signal by a pulsed L-band final amplifier. Because of its uncomplicated operating procedure it is suitable for use in a production line. The equipment consists of a basic phase bridge, a low noise video amplifier, and a noise power meter. A method of calibration system is analyzed. The system sensitivity in a 1-Hz bandwidth 1 kHz removed from the carrier is approximately 125 dB below the carrier.
Author (TAB)

N70-42578# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TEST AND EVALUATION OF IMPROVED AZIMUTH PULSE GENERATOR (APG) Final Report, Apr. 1968–Jul. 1970
Oliver D. Carlson Oct. 1970 21 p
(FAA-RD-70-64; FAA-NA-70-60) Avail: NTIS

Azimuth pulse generators and a digital-to-synchro converter were subjected to tests to ascertain their compliance with engineering requirements and to determine their performance in supplying antenna azimuth position data to a Radar Video Data Processor (RVDP). The azimuth pulse generators were installed in the antenna pedestal of the experimental airport surveillance radar (ASR-5) facility, and the digital-to-synchro converter was installed at the radar display subsystem. Utilizing digital computer programs, RVDP output messages were tabulated and analyzed to determine precision in reporting antenna azimuth. Test results indicated that the azimuth pulse generators and the digital-to-synchro converter performed satisfactorily, and acceptably provided antenna azimuth position data to the RVDP. Difficulties encountered during the tests were related to the type of coupling between the antenna and the azimuth pulse generators, which resulted in a recommendation to use only a worm-gear method of coupling.
Author

N70-42584# Norwegian Inst. of Tech., Trondheim. Div. of Radio Communication.
A 1500 METER ANTENNA MEASUREMENT RANGE
Kjell Bergh Dec. 1968 18 p Sponsored in part by Electron. Res. Lab. and Roy. Norweg. Council for Sci. and Ind. Res.
(ELAB-IR-115) Avail: NTIS

A 1500 m range antenna measurement site for measurements at cm and mm wavelengths is described. A 1 m diameter center-fed paraboloid antenna was designed with plug-in feeds. Three different feeds are at present available with center frequencies at 3.2, 8.75, and 36 GHz respectively. At 36 GHz a Cassegrain feed is used. A signal/noise ratio of 40 dB or better has been obtained at all three frequencies using the above antennas at both ends.
Author (ESRO)

N70-42623# Naval Research Lab., Washington, D.C.
MACHINE PLOTTING OF RADIO/RADAR VERTICAL-PLANE COVERAGE DIAGRAMS Interim Report
Lamont V. Blake 25 Jun. 1970 55 p refs
(AD-700625; NRL-7098) Avail: NTIS CSCL 17/9

Fortran computer subroutines have been developed for machine plotting of radar or radio vertical-plane coverage diagrams for the case of interference between direct and sea-reflected waves. One set of subroutines plots detection or constant-signal-level contours on a range-height-angle chart. A second set plots signal level in decibels as a function of range for a target at a fixed (low) altitude. The first type of plot is valid for antenna heights that are within a few hundred feet of the water and for targets that are at much higher altitudes and not too close to the horizon. The second type is valid for antenna and target heights that are both less than a few thousand feet altitude, with no restriction on minimum altitude. Normal atmospheric refraction is taken into account, but scattering and ducting are assumed to be of negligible effect. The frequency range considered is from about 100 MHz to 10 GHz. The factors taken into account are frequency, antenna and target heights, antenna beamwidth, tilt of the beam with respect to the horizon, roughness of the sea (wave height), polarization of the radio waves, and the calculated or assumed free-space range. Sample plots are shown and discussed. The plotting techniques employed are briefly described, and listings of the essential Fortran subroutines are given in an appendix.
Author (TAB)

N70-42657*# Texas A&M Univ., College Station. Remote Sensing Center.
DISCUSSION OF A MODEL OF THE APPARENT TEMPERATURE OF NATURAL SURFACES IN THE MICROWAVE RANGE
Jerry A. Richerson May 1970 31 p refs
(Grant NGL-44-001-001)
(NASA-CR-110832; RSC-10) Avail: NTIS CSCL 17I

Many important characteristics of a natural surface affect the emission of electromagnetic energy from this surface. The emission characteristics related to the differential scattering coefficients of the surface are discussed. Basic electromagnetic properties are defined and commonly used simplifying assumptions are stated. Peake's derivation of a general form of the Kirchhoff radiation law which predicts the angular and polarization dependence of the emitted energy is discussed. This model relates the emission and absorption characteristics to two measurable quantities, the backscatter and the apparent radiometric temperature of the surface. Comparison of theoretical and experimental values for both specular and diffuse surfaces show a good approximation is possible.
Author

N70-42708*# Michigan Univ., Ann Arbor. Electron Physics Lab.
EFFECT OF LONGITUDINAL ELECTROSTATIC FIELD ON THE WHISTLER MODE PROPAGATION IN A WARM MAGNETO-IONIC MEDIUM
H. C. Hsieh *In its* An Invest. of Nonlinear Interaction Phenomena in the Ionosphere Nov. 1969 14 p refs Repr. from J. Atmos. Terrest. Phys. (Northern Ireland), v. 30, 1968 p 213–226 refs
(See N70-42701 24-13)
(Grant NsG-696)
Avail: NTIS CSCL 17B

The dispersion equation for a whistler mode propagation in a warm plasma, subjected to parallel static electric and magnetic fields, is derived by using a linearized coupled Vlasov–Maxwell

equation. From the derived dispersion equation, the amplitude constant alpha and phase constant beta of the whistler mode are expressed in terms of static electric field E sub 0, static magnetic field B sub 0, the electron number density N sub 0, the electron temperature and the wave angular frequency omega. The effect of a weak static electric field on the propagation of a whistler mode is investigated in detail; the whistler mode may be amplified or attenuated according to whether E sub 0 and B sub 0 are in the same direction or in the opposite direction. The spatial rate of change of the wave amplitude and phase velocity of the whistler mode increase with E sub 0 in general. For a low-frequency wave propagation, alpha is directly proportional to E sub 0, omega, and N sub 0, and inversely proportional to B sub 0 cubed. A whistler mode propagation in the magnetosphere is also considered. The results of study show that the effects of a static electric field on the propagation characteristic of a whistler mode are likely to be more important in the region of low geomagnetic latitude and high altitude rather than in the high latitude region. Author

N70-42707*# Michigan Univ., Ann Arbor. Electron Physics Lab.
WHISTLER MODE PROPAGATION IN THE IONOSPHERE IN THE PRESENCE OF A LONGITUDINAL STATIC ELECTRIC FIELD
H. C. Hsieh *In its* An Invest. of Nonlinear Interaction Phenomena in the Ionosphere Nov. 1969 11 p refs Repr. from J. Atmos. Terrest. Phys. (Northern Ireland), v. 30, 1968 p 1219–1229 refs (See N70-42701 24-13)
(Grant NsG-696)
Avail: NTIS CSCL 17B

The effect of a longitudinal electrostatic field on whistler mode propagation was studied in a region of the ionosphere where the influence of particle collisions and ion motion may be significant. As an illustration, the propagation in two cases of interest was considered; one deals with the E-region in the neighborhood of 100 km height, and the other with the F-region in the neighborhood of 250 km. It is shown that the presence of a weak static electric field E sub 0 tends to reduce the attenuation of the forward whistler mode when the magnetostatic field B sub 0 and the electrostatic field E sub 0 are in the same direction. Moreover for a sufficiently large value of E sub 0 the whistler mode may experience an amplification. On the other hand, when E sub 0 and B sub 0 are in opposite directions an increase in E sub 0 tends to increase the attenuation of the wave. The variation of the attenuation constant, phase constant, and the phase velocity of the whistler mode with the signal frequency and with the electrostatic field is also discussed in detail. Author

N70-42708*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
PROPAGATION OF CIRCULARLY POLARIZED ELECTROMAGNETIC WAVES IN A FINITE TEMPERATURE ELECTROMAGNETOPLASMA
H. C. Hsieh *In its* An Invest. of Nonlinear Interaction Phenomena in the Ionosphere Nov. 1969 9 p refs Repr. from Phys. Fluids, v. 11, no. 7, Jul. 1968 p 1497–1505 refs (See N70-42701 24-13)
(Grant NsG-696)
Avail: NTIS CSCL 17B

The dispersion relation for circularly polarized electromagnetic waves in a warm two-component plasma subject to parallel static electric and magnetic fields was derived from the linearized coupled Boltzmann–Maxwell equations with the collision frequency assumed to be independent of the particle velocity. The effect of a weak longitudinal electrostatic field, E sub 0, on the propagation characteristic of the right- and left-hand circularly polarized waves in an isothermal electron-proton plasma is examined in detail and illustrated numerically for a conveniently chosen set of the system parameters. For the right-hand polarized wave the electrostatic field effect is found to be significant for a wave with frequency omega in the vicinity of the electron cyclotron frequency. Author

N70-42709*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
FOCUSING OF A RELATIVISTIC ELECTRON FLOW
H. C. Hsieh and J. E. Rowe *In its* An Invest. of Nonlinear Interaction Phenomena in the Ionosphere Nov. 1969 8 p refs Repr. from J. Appl. Phys., v. 39, no. 9 p 4199–4205 refs Sponsored by NASA (See N70-42701 24-13)
Copyright. Avail: NTIS CSCL 20G

The trajectory differential equation governing the motion of relativistic electrons is derived in terms of the scalar and vector potentials of the system using the principle of least action. The conservation of energy and momentum are used to develop the paraxial-ray differential equation describing the beam radius of a laminar-flow relativistic electron beam. The focusing of the electron beam in drift and accelerating regions was examined and the conditions for perfect balancing and nonspreading of a laminar-flow drifting beam are also derived. The equilibrium condition for Brillouin flow is shown. The variation of the normalized ripple amplitude and the scallop wavelength of a drifting beam is discussed. The profile of a beam accelerated in a uniform longitudinal electrostatic field is also illustrated. Author

N70-42712*# Texas A&M Univ., College Station. Remote Sensing Center.
WAVELENGTH DEPENDENCE OF BACKSCATTER FROM ROUGH SURFACE
John W. Rouse, Jr. Sep. 1970 28 p refs
(Grant NGL-44-001-001)
(NASA-CR-110833; RSC-12) Avail: NTIS CSCL 17I

The wavelength dependence of backscatter from a smooth undulating, randomly rough surface was examined experimentally using acoustic waves in water. The acoustic backscatter cross section for a statistically rough surface was measured over a broad, continuous range of wavelengths. The experiment revealed a transition region in which the wavelength dependence changed abruptly due to a null in the surface height spectrum. The wavelength dependence corresponds almost exactly to the measured surface height spectrum through the transition region in the manner predicted by the composite surface model formulated by Wright. The same transition effect is shown to exist in two independent radar sea clutter experiments in the wavelength region where the surface spectrum has a partial null caused by the transition between gravity waves and capillary waves in calm seas. The results presented demonstrate that a wavelength size-filtering or spectrum-filtering process, about which several authors have speculated, does exist. Author

N70-42715*# Hughes Aircraft Co., Culver City, Calif.
PARAMETRIC ANALYSIS OF MICROWAVE AND LASER SYSTEMS FOR COMMUNICATION AND TRACKING. VOLUME 1: SUMMARY
L. S. Stokes, ed. Washington NASA Oct. 1970 66 p refs
(Contract NAS5-9637)
(NASA-CR-1686) Avail: NTIS CSCL 17B

A fundamental objective of the study was to provide the mission planner and designer with reference data (weight, volume, reliability, and costs), supplementary material and a trade-off methodology for selecting the system (microwave or optical) which best suits his requirements. The material presented summarizes the: (1) significant results of the study program; (2) estimated best use for laser and microwave communications; (3) reference data for advanced space communication and tracking systems; (4) design criteria and trade-off methodology developed to select the best system for a given mission; and (5) future ground stations for space communications. Author

N70-42829*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A COMPARISON OF SIMULTANEOUS PHASE AND

AMPLITUDE FLUCTUATIONS IMPOSED ON SATELLITE SIGNALS BY F-REGION ANOMALIES
J. W. Porter 15 Jun. 1970 171 p refs
(Grant NGR-39-009-002)
(NASA-CR-113905; SR-357) Avail: NTIS CSCL 17B

The amplitude and phase variations of high frequency signals transmitted through the ionosphere from satellites were recorded and processed to allow intercomparison of seven different diffraction patterns obtained from one satellite pass. The amplitude patterns are on two harmonically related frequencies which are measured at each of two locations separated by one kilometer. The phase patterns are phase difference patterns between the two frequencies as measured at one location or between ends of the baseline using the same frequency. The diffraction theory was used to develop theoretical phase-modulating screen models and to obtain relationships between the patterns as they propagated behind the screen. The measured diffraction patterns were projected for comparison and sampled. Data analysis procedures included transfer of the various measured patterns back to the height of the screen by use of appropriate propagation factors. Author

N70-42896*# Martin Marietta Corp., Denver, Colo.
POTENTIAL APPLICATIONS OF DIGITAL TECHNIQUES TO APOLLO UNIFIED S-BAND COMMUNICATIONS SYSTEMS Final Report, 1 Jul. 1969 – 23 Feb. 1970
Feb. 1970 134 p refs Revised
(Contract NAS9-9852)
(NASA-CR-108300; MCR-70-34-Rev-1) Avail: NTIS CSCL 17B

The feasibility of digital transmission of real-time, standard format TV, together with voice and all the other data that must be returned from the Apollo spacecraft was studied. The principal benefit offered by a digital system is a reduction in the RF power required to transmit a good picture and reliable data. To achieve this improvement it is necessary to use two techniques, always considered together, made possible by converting to an all-digital system: error-correcting codes and data compression. Data compression makes each transmitted bit more important so that fewer errors can be tolerated, and error correction gives more improvement at low error rates. In selecting techniques for error correction and data compression hardware requirements and performance were considered. For decoding convolutional codes two methods were selected, sequential decoding and the Viterbi algorithm. Author

N70-42945# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE RESULTS OF THE LES-5 AND LES-6 RFI EXPERIMENTS, SUPPLEMENT 1
William W. Ward, Raymond L. Sicotte, K. H. Hurlbut, and C. J. Zamites, Jr. Bedford, Mass. ESD 2 Jul. 1970 11 p ref Prepared in cooperation with Aerospace Corp.
(Contract AF 19(628)-5167)
(AD-709766; TN-1970-3-Suppl-1; ESD-TR-70-194) Avail: NTIS CSCL 17/2.1

The report, a supplement to Lincoln Laboratory Technical Note 1970-3 (AD-703 766), presents the results of further computer processing of LES-6 RFI data taken during the period November 1968-October 1969. Author (TAB)

N70-42953# Naval Ship Systems Command, Washington, D.C.
THE 7TH ANNUAL TECHNICAL SYMPOSIUM: AN APPLICATION OF BAYESIAN TECHNIQUE FOR EARLY RELIABILITY MEASUREMENT
T. L. Pantz 1970 25 p refs
(AD-709386) Avail: NTIS CSCL 14/4

The paper deals with the application of a Bayesian measurement technique to the relisbility evaluation of a complex sonar system. This system is a multi-mode/path system capable of degraded performance in its operational modes. It consists of cabinets which contain functional equipment bays that are built-up from printed circuit cards and plug-in modules. Aspects related to modeling this system as well as the parameter selected for measurement, the mean time between unscheduled maintenance (MTBUM), are discussed. Author (TAB)

N70-43021# Naval Postgraduate School, Monterey, Calif.
A STUDY OF RADAR PULSE COMPRESSION USING COMPLEMENTARY SERIES TO MODULATE THE TRANSMITTED WAVEFORM
Gerald Joseph Sieren (M.S. Thesis) Dec. 1969 75 p refs
(AD-710382) Avail: NTIS CSCL 17/9

Pulse compression radars have resulted from the need to put more energy into a transmitted pulse by increasing the pulse duration, yet retaining or improving the target range resolution. FM chirp and phase-coded pulse compression using a single binary code to modulate the carrier are somewhat degraded by the amount of hash, or range sidelobes in the output of the matched-filter receiver. Pulse compression using complementary series, in which two binary series are transmitted, results in no range sidelobes in the detected pulse, since the autocorrelation functions of the two series completely cancel each other everywhere except at zero shift, where they add to produce a sharp peak with amplitude 2N times the received pulse amplitude, where N is the number of digits in each series. After introductory material on complementary series and pulse-compression systems, the thesis discusses the design, construction and testing of a pulse-compression system using complementary series of length four. The intent was to show feasibility, rather than to produce results using actual targets. Author (TAB)

N70-43041# Ionospharen-Institut Breisach (West Germany).
NEW FORMS OF METER WAVE ANTENNAS FOR USE IN PROBING-ROCKETS [NEUE FORMEN VON ANTENNEN FUER METERWELLEN IN RAKETENSONDEN]
A. Axmann and B. Dold Jun. 1970 29 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-35) Avail: NTIS; ZLDI Munich: 5,70 DM

Two frequencies are normally used for rocket measurements of electron content using the differential Doppler effect. Improvements are possible with a third frequency (100 MHz approx.) so new receiving antennas were developed. The first consists of a single turn helical copper tape (lambda/4 long) embedded in the fiberglass skin. The second is a loop antenna for high frequencies and the third consists of a two tube erectable dipole for simultaneous use as a Langmuir probe boom or triangular support for a retarding potential analyser. Impedance diagrams and radiation characteristics are discussed. Some of these devices were tested on recent ESRO sounding rockets. Author (ESRO)

N70-43084# Office of the Assistant Chief of Staff for Communications-Electronics (Army), Washington, D.C.
TACTICAL AUTOMATIC DIGITAL SWITCHING SYSTEM
L. R. Blair 1969 16 p refs
(AD-710298) Avail: NTIS CSCL 17/2

The paper reviews the development of the Tactical Automatic Digital Switching System (TADSS). It describes the procedures and techniques utilized to establish technical requirements and to define the demands of the military environment within which the system must operate and survive. The author discusses the set of performance categories and standard evaluation models which were established to enable the system to incorporate standard off-the-shelf commercial data handling devices. The measures taken to specially modify tactical equipment vans to provide environmental control and the high degree of mobility essential to rapid field deployment are treated in some detail. This is followed by a review of the test effort designed to assure that technical and environment requirements will be satisfied. Author (TAB)

N70-43121*# Texas A&M Univ., College Station. Remote Sensing Center.
ANALYSIS AND EVALUATION OF A FORWARD VIEWING SCANNING RADAR SCATTEROMETER SYSTEM
Richard Harrison Arnold (M.S. Thesis) Aug. 1970 138 p refs
(Grant NGL-44-001-001)
(NASA-CR-110866; RSC-14) Avail: NTIS CSCL 17I

A scanning scatterometer which integrates for 0.2 second the returning signal from a terrain element defined by a minimum Doppler frequency difference of 280 Hz was investigated to determine whether the allowed integration time is sufficient for a given terrain element size for an accurate determination of the scattering coefficient, and to develop methods for improving the measurement accuracy without altering the basic scanning technique. The scatterometer is analyzed by system subassemblies: transmission, reception, signal reduction and logic, recording, and CRT display. Possible klystron transmission frequency drift problems and potential calibration problems are discussed. The calibration system is analyzed with respect to system operations. An alternative system is presented and shown to be equal to or better than the proposed calibration system. Author

N70-43133*# Texas A&M Univ., College Station. Remote Sensing Center.
RADAR SCATTEROMETER DATA ANALYSIS: SEA STATE. NASA/MSC MISSION 20 AND MISSION 34
Richard W. Newton May 1970 22 p refs
(Grant NGL-44-001-001)
(NASA-CR-110865; RSC-09) Avail: NTIS CSCL 17B

An attempt to discover any characteristics which would distinguish the two sets of data from one another is reported. The missions were flown over different areas of the Atlantic Ocean involving two different types of sea, therefore, by extracting characteristic information from each set of data, the surface conditions could be inferred. The analysis was basically approached from an empirical sense and was only concerned with the information contained in the scatterometer data. The analysis was subjected to severe limitations due to an unavailability of all the data from the two missions and from a lack of sufficient ground truth. The analyses techniques did exhibit the fact that information relating to sea state was contained in the data, but further conclusions could not be drawn. D.L.G.

N70-43135*# Texas A&M Univ., College Station. Remote Sensing Center.
AN EXTENSION OF THE SLOPE-FACET MODEL OF RADAR BACKSCATTER FROM THE SEA
John W. Rouse, Jr. Sep. 1970 22 p refs
(Grant NGL-44-001-001)
(NASA-CR-110863; RSC-11) Avail: NTIS CSCL 17B

An extension of the slope-facet model is presented and consists of a unique approach to handling slope variations. In so doing an expression is developed for the normalized radar cross section which: (1) apparently applies for all angles removed from the vertical; (2) expresses the angular dependence as related to the wavelength dependence; (3) is a function of both the mean sea slope and the standard deviation of the slopes; and (4) provides a mechanism for calculating the upwind-downwind ratio as a function of slope statistics. Author

N70-43172*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIRECTIONS AND IMPLICATIONS OF COMMUNICATION TECHNOLOGY
Perry W. Kunns 7 Nov. 1970 20 p Presented at the Symp. on the New Commun. Tech. and its Social Implications, England, 1 - 7 Nov. 1970; sponsored by Intern. Broadcast Inst.
(NASA-TM-X-52911) Avail: NTIS CSCL 17B

Aspects of the development of communication technology are discussed. The specific technology areas reviewed include: low cost receivers for space broadcasting, high efficiency microwave tubes, solid state transmitters, shaped antenna beams, laser communications, information storage and retrieval, and orbit and frequency sharing. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N70-41848 California Univ., Berkeley.
COST OPTIMIZATION IN MULTI-PROCESSOR COMPUTER SYSTEMS
Gary Michael Giddings (Ph.D. Thesis) 1969 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-18923

The gain in computer performance which can be expected due to the parallel processing of program segments is determined. A finite state Markov model is developed for a computer system with M independent processors, from which the expected program run time is derived. The program run cost is developed as a function of the model parameters and is minimized at M* processors. Using the model it is shown that multiprocessing is justified by both the run cost decrease and the execution speed increase. A combined model is developed, in which the program is modeled as a tree of segments, each segment represented statistically. The states of the model represent the status of the work load of the system during the execution of the program. The bounds on run time and system cost are determined by considering a system with one processor and a system with an unlimited number of processors. The classical justifications for multiprocessing are improved real time execution speed and the possibility of improved reliability due to the redundancy of units. Dissert. Abstr.

N70-41853# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plants Div.
ANALYSIS OF MULTI-PARAMETER SYSTEMS BY ANALOG COMPUTER
V. Hrstka and R. Kalivoda 1970 11 p
(ZJE-73) Avail: NTIS

The analysis of multi-parameter controlled systems by means of an electronic analog computer (differential analyser) is presented. Special care is devoted to nonstandard solutions of problems from the field of control of nuclear reactors on an electronic analog computer. Author (NSA)

N70-41883# National Aeronautical Lab., Bangalore (India).
A MODIFIED MULTHOPP'S LIFTING SURFACE THEORY AS PROGRAMMED FOR THE NAL SIRIUS COMPUTER
P. Ramamoorthy and C. L. Narayana Oct. 1969 34 p refs
(NAL-TN-17) Avail: NTIS

A modified version of Multhopp's lifting surface theory, programmed for NAL Sirius computer, is presented. Aerodynamic characteristics are determined for a number of composite planforms and compared with those existing in the literature. Some interesting comparisons are made with the results obtained from electrical analog methods. The method is also applied to cambered wings and gives excellent results. Author

N70-41911# Ceskoslovenska Akademie Rez. Ustav Jaderneho Vyzkumu.
DIGITAL SPECTRUM STABILIZER WITH ANALOG

CORRECTION
Z. Kosina Apr. 1970 8 p refs
(UJV-2378-A) Avail: NTIS

A digital stabilizer for controlling the conversion gain or the zero energy intercept of a Wilkinson-type ADC is described. The stabilizer corrects the effects of all-system drifts by taking as a reference one of the natural or pulser-injected peaks of the spectrum under analysis. By using an analog-memory correction register, the number of logic elements has significantly been reduced in comparison with conventional systems of similar performance. Author (NSA)

N70-41927# Bolt Beranek, and Newman, Inc., Van Nuys, Calif.
A DIGITAL COMPUTER PROGRAM FOR COMPUTATION OF NOISE EXPOSURE FORECAST CONTOURS Final Report
Richard D. Horonjeff and Allan Paul Jun. 1970 135 p refs
(Contract FA68WA-1900)
(FAA-NO-70-6) Avail: NTIS

A detailed description of the digital computer program developed for the computation and plotting of noise exposure forecast contours is presented. All routines including flow charts, program listings, and internal data organizations are provided. A brief summary of the basic noise exposure forecast concepts and equations are included. Author

N70-41961* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHASE-SHIFT DATA TRANSMISSION SYSTEM HAVING A PSEUDO-NOISE SYNC CODE MODULATED WITH THE DATA IN A SINGLE CHANNEL Patent
James C. Springett, inventor (to NASA) Issued 21 Feb. 1967 (Filed 14 May 1963) 12 p Cl. 178-67 Sponsored by NASA
(NASA-Case-XNP-00911; US-Patent-3,305,636;
US-Patent-Appl-SN-280777) Avail: US Patent Office CSCL 09B

A digital data transmission system and the underlying theory are described for communication systems such as those transferring telemetry or command data between spacecraft and ground stations. Digital data are used to modulate the pseudo-noise synchronization code so that both the synchronization and data information appear on a single channel. The system operates efficiently because all available sideband transmitting power is applied to the single channel. The jitter is reduced because the frequency of the data carrier is 1/4 that of two channel systems. N.E.N.

N70-41983*# Radio Corp. of America, Somerville, N.J.
THRESHOLD LOGIC IMPLEMENTATION OF A MODULAR COMPUTER SYSTEM DESIGN
D. Hampel, J. H. Beinart, and K. J. Prost Washington NASA Oct. 1970 73 p refs
(Contract NAS12-2130)
(NASA-CR-1668) Avail: NTIS CSCL 09B

Several portions of logic of the NASA modular computer, to be built with LSI, were designed with threshold logic. Some of the designs were compared with TTL NAND gate implementations. The logic designs for each function were characterized by total component count, connections, speed and power. The threshold logic circuits used arrays of current switching modules to realize such functions as parity, parallel shift and rotate logic, decoding, registers and counters. The designs were based on a family of integrated threshold gates developed in 1968 - 1969 and which were shown to be amenable to LSI. New circuit techniques are shown to simplify logic where, traditionally, pure threshold logic has not shown advantage. Author

N70-41995# California Univ., Berkeley. Dept. of Electrical Engineering.
RESEARCH IN THE THEORY OF AUTOMATA AND COMPUTING Final Scientific Report, 1 Jul. 1969 - Jul. 1970
M. A. Harrison Jul. 1970 5 p refs
(Grant AF-AFOSR-1845-70)
(AD-709709; AFOSR-70-2012TR) Avail: NTIS CSCL 9/2

During the last year of the contract, the research activities were the following: Linear sequential machines; Computational complexity of parsing; Counting theorems; and Cataloguing linear post function classes. TAB

N70-42006# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
COUPLING CAMAC TO COMPUTERS
A. Lewis May 1970 6 p
(AERE-R-6407) Avail: HMSO 1s 9d; BIS $.40

The interaction between CAMAC and a computer is through a hardware coupler and an appropriate software executive. This paper discusses some basic parameters and lays the groundwork for machine independent software. Author (NSA)

N70-42008# Naval Research Lab., Washington, D.C.
METHODS FOR CALCULATING AND ANALYZING INTERROGATION REPETITION FREQUENCY SETS NONSYNCHRONOUS FOR N INTERROGATIONS Interim Report
William K. Gardner 11 Jun. 1970 45 p refs
(AD-709553; NRL-7071) Avail: NTIS CSCL 17/7

A simple means of using a computer to determine sets of nonsynchronous interrogation repetition frequencies was devised and is presented along with some tables of results. When nonsynchronous interrogation repetition frequencies are used, the interrogations from any interrogator can experience no more than one interference per scan from the interrogations transmitted by any other interrogator. Thus, if k interrogators are beamed toward the same transponder, the interrogations from each can experience at most k - 1 interferences per scan. Application of this principle to beacon systems should eliminate lost targets caused by synchronous interference between interrogations. Author (TAB)

N70-42035*# Maryland Univ., College Park. Computer Science Center.
A MICROPROGRAMMED ALLOCATING-LOADER
Yaohan Chu Sep. 1970 32 p refs
(Grant NGR-21-002-206)
(NASA-CR-114162; TR-70-135) Avail: NTIS CSCL 09B

A description is given of an organization for allocating and loading an executable code relative to an origin into the main memory by a 10 word microprogram. The main memory is organized into pages and their activities are kept tract of by a small capacity but very fast associative memory. During allocation and loading, the code is not modified in any manner. The physical addresses of the instructions and operands of the code are not known until the time of execution of the code. This is called the dynamic addressing. The addressing technique, the sequence chart, and the description of the microprogram are presented in great details in the computer design language. Author

N70-42056# Lincoln Lab., Mass. Inst. of Tech., Lexington.
EDUCATIONAL TECHNOLOGY PROGRAM Quarterly Technical Summary Report
15 Jun. 1970 22 p ref
(Contract AF 19(628)-5167)
(AD-709188; ESD-TR-70-154) Avail: NTIS CSCL 5/9

Contents: Program; LTS-1 system hardware, system software, LTS-2 design considerations concept, design details. TAB

N70-42104# Argonne National Lab., Ill.
SYMBOLIC DERIVATIVE TAKER FOR A SPECIAL PURPOSE LANGUAGE FOR LEAST SQUARES FITS

Marian Gabriel Feb. 1970 72 p refs
(Contract W-31-109-eng-38)
(ANL-7628) Avail: NTIS

A computer program for performing symbolic differentiation of FORTRAN formulas is described. The process by which formulas are analyzed, their analytic derivatives found, and the resulting derivative expressions simplified is described in detail. A program listing and a sample output are included. Author

N70-42128# Illinois Univ., Urbana. Dept. of Computer Science.
STANDARDIZATION OF CONTROL POINT REALIZATION
Ronald Gustav Martin (M.S. Thesis) May 1970 62 p refs
(Contract AT(11-1)-1018)
(COO-1018-1206; Rept-400) Avail: NTIS

A design technique or method was developed to provide a standardized design approach to control logic. The specific technique chosen produced a comprehensive set of sequentially ordered control diagrams (flow charts) which could be converted directly to logical drawings using certain standard modeling procedures (control point). Additional consideration was given to such areas as control reliability, hardware realization, and the ease of control maintenance. Author

N70-42147# Illinois Univ., Urbana. Coordinated Science Lab.
MAJORITY LOGIC DECODABLE ERROR-CORRECTING CODES BASED ON BLOCK DESIGNS
Spencer W. Ng Jul. 1970 46 p refs
(Contract DAAB07-67-C-0199; Grant NSF GK-2339)
(AD-709333; R-480; UILU-ENG-70-225) Avail: NTIS CSCL 9/4

In recent years, much work has been done in the area of majority logic decoding, and with good reasons. In the first place, majority logic decoding can be very simply implemented. While the BCH codes are the best known class of codes for correcting large multiple errors, the complexityof its implementation leaves something to be desired. On the other hand, although most of the known majority logic decodable codes are somewhat inferior to the BCH codes, the simplicity of a majority logic decoder and the ease of decoding give this method of decoding an attractive prospect. Secondly, majority logic decoding automatically corrects many more patterns of errors other than those guaranteed by the decoding schemes without any additional equipment. This can be achieved by the BCH codes only with a lot of extra equipment. These two features of the majority logic decoding are motivations enough for its further study. Author (TAB)

N70-42148*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
HYBRID COMPUTER OPTIMIZATION OF SYSTEMS WITH RANDOM PARAMETERS
Robert Cantey White, Jr. (Ph.D. Thesis) 1970 171 p refs
(Grant NGL-03-002-024)
(NASA-CR-114258) Avail: NTIS CSCL 09B

A hybrid computer Monte Carlo method for optimization of systems containing random parameters is presented. The system parameters are treated as random variables having Gaussian probability distributions. The dynamical system, including the random variations in the system parameters, is simulated on a fast repetitive analog computer and the average system performance is estimated by the Monte Carlo method. A small digital computer controls the operation of the analog machine and implements an optimization algorithm for determining the optimal parameter means and variances. The optimization program incorporates provisions for interaction between the operator and the algorithm by a cathode ray tube display console and the accumulator switches on the digital computer. The method is applied to the optimization of the means and variances of two guidance-unit parameters in a hypothetical radar-homing missile. Author

N70-42196*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ALGORITHMIC ASPECTS OF SEQUENTIAL DECODING
John M. Geist Aug. 1970 124 p refs
(Grant NGL-15-004-026)
(NASA-CR-110789; TR-EE-702) Avail: NTIS CSCL 09B

Sequential decoding procedures are studied in the context of selecting a high-value path through a metric tree. Several algorithms are considered and their properties compared. For the conventional Fano algorithm, it is noted that the difficulty in decoding depends on the minimum node value along the correct path. This minimum is a random variable and it can be modeled in terms of Markov chains. Some properties of such Markov chains are studied. A stack algorithm introduced by Zigangirov and Jelinek is presented, and it is shown that this algorithm is essentially equivalent to the Fano algorithm with regard to the set of nodes examined and the path selected, although the description and action of the two algorithms are different. A modified Fano algorithm is introduced, in which the quantizing parameter is eliminated and decisions are based on exact node values rather than on quantized values. Extensive computer simulations comparing the Fano algorithm with a quantized Zigangirov-Jelinek algorithm are reported. The possibility of using sequential tree search algorithms for searching more general graphs is investigated. Author

N70-42165*# Arizona Univ., Tucson. Computer Science Research Lab.
A DIGITAL CONTROLLER PROGRAM FOR ANALOG-SIMULATED SYSTEMS (LOCUST/PDP-9 HYBRID)
W. R. Moore Sep. 1970 47 p refs
(Grant NGL-03-002-024)
(NASA-CR-114232; CSRL-Memo-211) Avail: NTIS CSCL 09B

A PDP-9 Assembly language program is described which allows direct implementation of the z-transform of the transfer function of a linear digital controller of any order up to sixth. This controller is interfaced to the LOCUST hybrid computer through a single ADC/MDAC pair and several control lines. No provision is made for state variable control. The upper bound on the sampling rate is 4khz due to the conversion time of the ADC used. This maximum is seldom realizable except for systems of less than third order due to the time consumed by the digital program in doing multiplications. Author

N70-42188*# TRW Systems Group, Redondo Beach, Calif.
AN ALL MONOLITHIC MOS A/D CONVERTER: LOW POWER CLOCKS, MULTIPLEXERS, REGISTERS, AND A/D CONVERTER Final Report
James Eastman and Archie MacMillan 30 Jun. 1970 118 p
(Contract NAS8-23072)
(NASA-CR-102863; TRW-12529-6001-R0-00) Avail: NTIS CSCL 09B

A review of the work to develop an all monolithic, MOS, 10 bit, analog-to-digital converter is presented. First the converter design goals are given, and then a functional description of the conversion method is discussed. This is followed by a detailed analysis of the circuit design. The converter design is then broken into its subfunctions and test results from each of the subfunctions are compared to the desired results. The validity of the method of conversion employed is proven by test results from a converter showing 7 bit accuracy at 5 k conversions/sec over a given input voltage range. The problems in the existing A/D design are identified and changes to correct these problems are presented. A system which has a multiplexer at the input to the A/D converter, a serial-to-parallel converter at the output, and a two phase clock generator to drive all of them is described. The compatibility of each of the devices is demonstrated. Detailed test procedures and test data for each of the devices (multiplexers, serial to parallel converters and clock drivers) are given. Author

N70-42210# Illinois Univ., Urbana. Coordinated Science Lab.
AN APPROACH TO ARTIFICIAL NONSYMBOLIC COGNITION
Franco P. Preparata and Sylvian R. Ray Jul. 1970 36 p refs
(Contracts DAAB07-67-C-0199; OE-C-1-7-071213-4557)
(AD-709332; R-478; UILU-ENG-70-223) Avail: NTIS CSCL 6/4

The paper describes an approach to the artificial recognition of events of a nonsymbolic nature, such as the bidimensional perspective views of scenes of the everyday world. Scenes are presented as colored pictures and the objective of the cognitive task is the labeling of the interpreted scene objects. The method is based on three major components: a preprocessed version of the scene (stimulus), a semantic map, and an algorithm which attempts interpretation of the stimulus under the guidance of the semantic map. The algorithm is sequential and proceeds from general to specific, thereby achieving efficient tree-pruning (contextual elimination). Stimulus interpretation is based on attribute-value matching, but classification relies strongly on the accumulated context. Backtracking provisions are available for correction of earlier wrong hypotheses. Experiments are presented and described.
Author (TAB)

N70-42221# Oak Ridge National Lab., Tenn.
ORNL BASIC COMPILER
J. G. Sullivan and J. R. Stockton Jul. 1970 24 p ref
(Contract W-7405-eng-26)
(ORNL-TM-3042) Avail: NTIS

The ORNL BASIC compiler essentially converts a BASIC program to a FORTRAN program and then proceeds by using the FORTRAN compiler already available. All commands normally contained in elementary and advanced BASIC are included. In addition, commands for reading and writing permanent data files are provided. In the current version of the compiler, the data files are restricted to symbolically coded decimal files on magnetic tape. Matrix commands are not included, and it is assumed that the user is familiar with the BASIC language.
Author

N70-42230*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ON THE INVERTIBILITY OF FINITE STATE MACHINES
Raymond R. Olson 23 Jul. 1970 113 p refs
(Grant NGL-15-004-026)
(NASA-CR-110770; TR-EE-703) Avail: NTIS CSCL 09B

Necessary and sufficient conditions for the general class, as well as some important subclasses, of finite state machines to be invertible with delay L (called INV L if L is the least delay for which an inverse exists) are given. Some structural properties of INV L strongly connected machines with input and output sets of common order are derived. It is shown that every state on such a machine allows the same number of output sequences of length L or longer. It is also shown that every set of final states, reachable from some known initial state with common output sequence of length L or longer, has identical cardinality. The concepts of information losslessness and information losslessness of finite order are considered and related to invertibility. A necessary and sufficient condition for information losslessness in the case of strongly connected machines with equal order input and output sets is given.
Author

N70-42243# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
A HYBRID COMPUTER SYSTEM SIMULATION FOR DETERMINING OPTIMAL POLICY VARIABLES IN s, t INVENTORY PROBLEMS
B. D. Sivazlian and P. E. Valisalo May 1970 24 p refs
(Contract DAHC04-68-C-0002; Proj. Themis)
(AD-709636; THEMIS-UF-TR-34; AROD-T-1-49-RT; TR-34) Avail: NTIS CSCL 15/5

The report discusses a mathematical model for a periodic review inventory control problem of a single commodity system where the demand per period for the commodity is described by a continuous random variable epsilon ($0 < \text{epsilon} < \text{infinity}$) with probability density function phi(epsilon) identically and independently distributed from period to period.
TAB

N70-42251# Illinois Univ., Urbana. Dept. of Computer Science.
COMPUTER SYSTEMS RESEARCH Annual Report, 1 Sep. 1969 – 31 Aug. 1970
C. W. Gear and W. J. Poppelbaum 31 Aug. 1970 102 p refs
(COO-1469-165) Avail: NTIS

Generalized modeling support programs for the PDP-8 computer system are reported as well as subroutines developed from work on stiff differential equations and singular matrices. System and circuit designs are summarized for computerized equipment including a display processing unit for a multiterminal network, a system for on-line Fourier transforms, a linear image transformer, a stereotelevision without polarizing filters, a 3-D display system, and a colored landscape, pattern recognition machine.
J.M.

N70-42255# Harvard Univ., Cambridge, Mass.
THE DESIGN AND IMPLEMENTATION OF A CONVERSATIONAL EXTENSIBLE LANGUAGE
Jay M. Spitzen May 1970 82 p refs
(Contract F19628-68-C-0101)
(AD-709361; ESD-TR-70-141) Avail: NTIS CSCL 9/2

The report describes CEL, a conversational extensible language. Its syntax, data, control structures and conversational features are presented and compared to those of other languages. Its use is illustrated by means of several examples in the areas of list processing, polynomial arithmetic, formula manipulation, vector arithmetic, trees and syntax analysis, complex and rational arithmetic and block structure and own variables.
Author (TAB)

N70-42265# Iowa Univ., Iowa City. Dept. of Mathematics.
A REVIEW OF ALGORITHMS FOR OPTIMIZATION
James J. Hurt Jul. 1970 50 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-709581; THEMIS-UI-22) Avail: NTIS CSCL 13/6

The purpose of this paper is to present several of the better algorithms for finding the best state of some system. In so far as it is possible, these algorithms will be compared and their relative merits and demerits will be described. A small attempt is made at proving convergence of each algorithm and no attempt is made to prove rates of convergence. A bibliography with comments is included for reference.
Author (TAB)

N70-42350# Rome Univ. (Italy). Inst. of Physics.
COMBINATIONAL AND SEQUENTIAL TECHNIQUES FOR THE COMPRESSION OF BINARY DATA WITH APPLICATION TO SPACE PHYSICS EXPERIMENTS
S. Cantarano, G. V. Pallottino, and F. Palutan 25 Mar. 1970 115 p refs *Its* Nota Interna No. 258
Avail: NTIS

Data compression techniques for spacecraft communication are outlined. Some are compressed at the time of counting and counting laws, such as the logarithmic one and those based on the statistical error pertinent to a stream of random pulses, are discussed. Other binary number compression techniques, such as the floating point technique and combinatorial networks and read-only-memories are described. Some of the techniques are being used on the ESRO HEOS satellites and the Italian SIRIO satellite.
ESRO

N70-42386*# Maryland Univ., College Park. Computer Science Center.
DESIGN OF AN ALGOL MACHINE
Thomas F. Signiski Sep. 1970 184 p refs
(Grant NGR-21-002-206)
(NASA-CR-114159; TR-70-131) Avail: NTIS CSCL 09B

The design of a syntax-directed machine whose language is a subset of ALGOL is described. This machine is described in the Computer Design Language (CDL). The subset of ALGOL is discussed. Memories and registers as well as the allocations of the memories for serving functional elements such as stacks are described. Program execution by the machine is illustrated in detail. A set of sequence charts is presented to implement the syntax-directed algorithm. This work aims to demonstrate the feasibility of a high-level language processor and to illustrate the use of the CDL to describe it. Author

N70-42370*# Ryan Aeronautical Co., San Diego, Calif.
A STUDY TO DEFINE A SCATTEROMETER DATA PREPROCESSING SYSTEM Final Report
R. E. Chapman and F. J. Killion 31 Jul. 1970 277 p refs
(Contract NAS9-9723)
(NASA-CR-108638; Rept-74267-1) Avail: NTIS CSCL 09B

The investigation reported was prompted by the immediate need for processed data from the four NASA scatterometers upon completion of a NASA remote sensor aircraft flight mission. The study shows unequivocably that an airborne real-time data preprocessor is capable of immediately producing accurate normalized radar backscattering area data of terrain for most missions. The feasibility of the data preprocessor is presented. A design of data preprocessor incorporating modern techniques and components has been accomplished which is compatible with the NASA aircraft systems. The following important advantages are possible with the addition of the airborne data preprocessor: (1) an estimated 82% reduction in processing time; (2) an estimated 75% to 80% reduction in processing cost; (3) a quick-look airborne display; (4) improved accuracy and reliability of radar backscatter (sigma-zero) data; (5) greater data-gathering flexibility; and (6) lower aircraft operations cost. Author

N70-42440 Pennsylvania Univ., Philadelphia.
MULTILEVEL TECHNIQUES FOR OPTIMIZATION AND IDENTIFICATION OF LARGE-SCALE LINEAR DYNAMIC SYSTEMS
Donald Alexander Orr (Ph.D. Thesis) 1969 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-21412

Algorithms are presented for the identification and optimization of large-scale linear discrete time systems. Multilevel technique is adopted to simultaneously identify and optimize the selected subsystems with their individual goals. The coordination between the goals of the subsystems and that of the overall system is achieved through intervention parameters. It is shown that the identification using stochastic approximation algorithms in a multilevel sense converges to true system values. A cyclic optimization process using present subsystem estimates also converges to within a tolerance of the control policy of the overall system. The controller improves its capability by utilizing the information derived from the identification process. Tests are presented to determine the convergence properties associated with a particular set of subsystems. Dissert. Abstr.

N70-42458# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PATTERN RECOGNITION
I. T. Turbovich 4 Jun. 1970 331 p refs Transl. into ENGLISH from the book "Opoznanie Obrazov" Moscow, Nauka Press, 1968 p 1-228
(AD-709352; FTD-HC-23-415-69) Avail: NTIS CSCL 6/4

The recognition of sonic and visual patterns is discussed. Special attention is devoted to the algorithmization of processes for creating signs and arriving at solutions. Also examined are the principles of constructing algorithm-recognition machines, methods of processing descriptions, the evaluation of similarities, and other problems connected with theory and experimentation of pattern recognition. There is a bibliography of 180 titles. TAB

N70-42492 California Inst. of Tech., Pasadena.
BINARY CODING USING STANDARD RUN LENGTHS
John Irving Molinder (Ph.D. Thesis) 1969 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-19599

Run length coding using standard run lengths has been proposed. The analysis has been mostly experimental for specific types of data. In this thesis the globally optimum single standard run length has been derived for the binary independent source and globally optimum single standard run lengths of zeros and ones have been derived for the binary first order Markov source. It is assumed that the output symbols are subsequently block coded in each case. A recursion relationship between standard run lengths is derived for two specific coding algorithms. A simple single standard run length scheme using a non-block code on the output symbols has also been derived for the binary independent source. Dissert. Abstr.

N70-42507 Connecticut Univ., Storrs.
INCOMPLETELY SPECIFIED AND TIME VARYING PROBABILISTIC AUTOMATA
Bernard Wentzel Lovell (Ph.D. Thesis) 1969 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-1284

The probabilistic finite-state automaton or sequential machine has been almost invariably considered as the stochastic extension of the completely-specified non-time-varying deterministic machine. This work considers the incompletely specified constant probabilistic machine and the time-varying probabilistic machine from the viewpoint of machine equivalence and reduction of redundantly expressed machines to forms with fewer states. The necessary definitions and constructions are developed to carry out these aims for the first of these types and for some categories of the second. Dissert. Abstr.

N70-42517 Princeton Univ., N.J.
SCHEDULING OF COMPUTATIONS OF MULTIPROCESSOR SYSTEMS: THE PREEMPTIVE ASSIGNMENT DISCIPLINE
Richard Robert Muntz (Ph.D. Thesis) 1969 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-18180

One of the important potentials of multiprocessor computer systems is the ability to speed the completion of a computation by concurrently executing independent portions of the job. Computations are modeled as a partially ordered set of tasks and the execution time of each task. The scheduling of such computations with a number of identical processors with the object of minimizing the run time of the computation is considered. Scheduling disciplines are introduced in which processor-sharing and/or preemptions are permitted. A hierarchy of these disciplines is defined in terms of the computation time they can achieve. The preemptive scheduling discipline is studied in depth. Some fundamental questions, such as whether an optimal preemptive schedule exists, are answered. Applications of preemptive scheduling to related research are discussed. Dissert. Abstr.

N70-42848# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
ERROR-TOLERANT SEQUENTIAL CIRCUIT DESIGN USING

ERROR-CORRECTING CODES Interim Technical Report
Ronald Wayne Larsen (Ph.D. Thesis) Jun. 1960 161 p refs
(Grants AF-AFOSR-1555-68; DA-ARO(D)-31-124-G1045)
(AD-710210; USCEE-388; AFOSR-70-2178TR) Avail: NTIS CSCL 9/2

Redundancy is an important technique in the design of error-tolerant electronic computers. Many redundant schemes have been proposed and developed for combinational circuits; this study is directed toward redundant schemes for general computing circuits, specifically, sequential circuits. The design of error-tolerant sequential circuits using error-correcting codes is approached from a practical as well as theoretical viewpoint with the language of sequential machine theory and coding theory being unified into a foundation for error-tolerant sequential machine theory. Various synthesis procedures are presented for synchronous sequential circuits which tolerate transient errors and permanent failures. The effectiveness of these procedures is evaluated in detail for a simple example, the eight-state binary counter. Using exponential failure distributions, it is shown that reliability is significantly improved for mission times of long duration for this example. Author (TAB)

N70-42553*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAMMING SUPPORT OF SERT 2 CONTROL CENTER
Paula J. Bettinger and Theodore H. Sheridan Washington Oct. 1970 7 p
(NASA-TM-X-2121; E-5882) Avail: NTIS CSCL 09B

Computer support of the SERT 2 (Space Electric Rocket Test) control center provides visual display of spacecraft data. The real-time data are limit checked and converted to engineering units so they can be easily read by project engineers. Author

N70-42587# University Coll., London (England). Mullard Space Science Lab.
THE USE OF COMPUTERS ON BOARD SMALL SCIENTIFIC SPACECRAFT
W. M. Glencross, R. W. Penny, and W. J. Raitt Paris ESRO Mar. 1970 53 p refs
(ESRO-SN-109) Avail: NTIS

Onboard spacecraft computer concepts are outlined and the major improvements arising when such a computer is incorporated into the telemetry system are described. A possible specification for a computer on a small scientific spacecraft is developed based on current work both in Europe and the U.S.A. The relationships between large ground-based data processing facilities and onboard computers show that they complement each other so improving the scientific performance of the mission. The technological implications of the computer specification and examples of the way in which a computer could be used to assist typical experiments are also considered. Author (ESRO)

N70-42595# RAND Corp., Santa Monica, Calif.
THE IMPACT OF FUTURE DEVELOPMENTS IN COMPUTER TECHNOLOGY
William R. Graham Jun. 1970 16 p refs Presented at the Joint AF and Lockheed Aircraft Conf. on Computer-Oriented Analysis of Shell Struct., 13 Aug. 1970
(AD-710262; P-4401) Avail: NTIS CSCL 9/2

Computer hardware design is progressing at such a rate that it is difficult to understand where it is now, much less where it is going. On the other hand, computer software still exists only as a pre-science technology, and therefore it is very difficult to make any generalizations about its status, other than to say that it is a sufficiently primitive art to require the name Computer Sciences in most centers of research. The paper makes an attempt to move away from analyzing computer capability only in terms of raw hardware speeds, and tries to give a rounded picture of the disadvantages as well as the advantages of some radically new machine designs. The point of view is that of a person interested in solving very large and complex problems. Author (TAB)

N70-42637*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE SCIENCES DATA HANDLING: PRESENT CAPABILITIES AND REQUIREMENTS FOR FUTURE LARGE ASTRONOMY MISSIONS
George H. Ludwig Aug. 1970 24 p Presented at Optical Telescope Technol. Workshop, Huntsville, Ala., 28 Apr.–1 May 1969
(NASA-TM-X-65363; X-560-70-291) Avail: NTIS CSCL 09B

The present state-of-the-art for processing data from space sciences missions is reviewed and the new technology that will be required for future missions is analyzed. The problem considered can be separated into four elements: (1) acquisition of the data from the spacecraft; (2) relay to a central processing point; (3) processing to meet operational needs; and (4) processing to meet in-depth analysis needs. The study assumes that the data acquisition, communication, and data relay networks will exist at the time large optical telescopes are launched, so that the data transmitted from them can be assembled at a common data collection point within the necessary time constraints. D.L.G.

N70-42639# RAND Corp., Santa Monica, Calif.
THE MIND SYSTEM: THE STRUCTURE OF THE SEMANTIC FILE
Martin Kay and Stanley Y. W. Su Jun. 1960 69 p
(Contract F44620-67-C-0045)
(AD-709875; RM-6265/3-PR) Avail: NTIS CSCL 9/2

The study provides a detailed description of the way in which the main fact file of the MIND information-management system is organized. The format of each type of record is given in the form of a declaration in the PL/1 programming language. A method is described for organizing long lists of items so that any desired entry on the list can be retrieved with a minimum of accesses (usually one) to the disk. Also included is a set of computer procedures which can be incorporated into any program that has cause to refer to the file. These make it easy to store and retrieve information and to relieve the programmer of the necessity of bearing all the details of the file representation constantly in mind. Author (TAB)

N70-42676# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR AND SPECIAL-PURPOSE UNITS FOR AN ANALOG COMPUTER COMPLEX
G. A. Mezei et al 28 May 1970 15 p ref Transl. into ENGLISH from the book "Sredstva Analogovoi i Analog-Tsifrovoi Vychislitelnoi Tekhniki" Moscow, 1968 p 129–136
(AD-710258; FTD-HC-23-119-70) Avail: NTIS CSCL 9/2

An analog computing system is developed. For simulating nonlinear dynamic systems, the following units are needed: a function multiplier, a universal nonlinear unit of single-variable functions, and a special switchable-structure unit. The function multiplier is designed with two operational amplifiers with varistor-type squarers; this unit can generate given relationships, and given functions; maximum multiplication error, 0.5 percent, division error, 5 percent, in multiplying 100-v ac by 100-v dc signals, phase distortion appears at 500 Hz. The universe nonlinear unit consists of diodes and resistors and has two output amplifiers; by reversing reference and diode voltages, various characteristics are obtained; temperature stability is achieved through thermostatic control. A special switchable-structure unit is planned; it will include

backlash, coordinate restriction, dead zone, squarer, sine-cosine converter, relay characteristic, and other nonlinear schemes mounted on separate switchable plates. TAB

N70-42686# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HYBRID STORAGE AND INTERPOLATING DEVICES FOR A DIGITAL COMPUTER
S. A. Ginzburg et al 3 Jun. 1970 19 p refs Transl. into ENGLISH from the Publ. 'Vsesoyuzoye Soveshchaniye po Antomaticheskomu Upravleniyu (Teknicheskoy Kibernetiki), 30, Odessa, 1965. Mnogosvyaznye i Invariantnyye Sistemy. Nelineynyye i Diskretnyye Sistemy. Trudy' Moscow, Izd-Vo ' Nauka ', 1968 p 525–534
(AD-710256; FTE-HC-23-117-70) Avail: NTIS CSCL 9/2

Special analog-digital devices for storing and interpolating functions in a digital computer are considered. Nodes in an (n plus 1)-dimensional space can have either an orderly or an arbitrary arrangement. As function values are specified at the nodes, the generalized Lagrange interpolation polynomial is used; it ensures smaller equipment and higher speed than the Newton interpolation formula. Three schemes are briefly considered: (1) digital storage, analog interpolation; (2) analog storage, digital interpolation; (3) digital storage, hybrid interpolation. Comparison shows that the first scheme is the simplest; error largely determined by its analog part is 1-0.1 percent; the third scheme has the highest accuracy; complexity of its digital part sharply increases with the number of independent variables. Author (TAB)

N70-42744 Illinois Univ., Urbana.
RASCEL: A PROGRAMMABLE ANALOG COMPUTER BASED ON A REGULAR ARRAY OF STOCHASTIC COMPUTING ELEMENT LOGIC
John William Esch (Ph.D. Thesis) 1969 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 70-843

Input numbers are converted inside the system to a mapped ratio representation which consists of two clocked random pulse sequences, one representing a numerator and the other the denominator. The machine value of one of these sequences is the probability that a logical one will occur during a clock period. The probability of a logical number occurring can be a continuous time varying function and the basic arithmetic operations of addition, subtraction, multiplication and division can be performed with simple logic gates. A programmable stochastic computing element was designed which can be programmed to perform on its two inputs, a and b, any of the operations a, b, a sq, b sq, a+b, a−b, a x b, a/b. These computing elements are permanently wired together in a tree structure which allows any function of this structure's inputs to be implemented by the computer. Any other function can be computed by just reprogramming the computing elements. Dissert. Abstr.

N70-42814# Sandia Corp., Albuquerque, N.Mex. Radiation Div.
A COMPARISON OF TWO UNFOLD CODES: UNSPEC AND SPECTRA
Marshall Berman Mar. 1970 31 p Sponsored by AEC
(SC-RR-70-96) Avail: NTIS

Two unfold codes, UNSPEC and SPECTRA, were applied to a set of test problems. The ability of each code to unfold the spectrum was studied for the following cases: exact measurements and exact trial spectrum; measurements with errors and the exact trial spectrum; exact measurements and a false trial spectrum; and errors in both the measurements and the trial spectrum. The test problems also included the study of the effect of various detector systems, i.e., ones with broad, medium, and narrow responses. When SPECTRA was able to produce sensible answers in the overdetermined LIMIT mode, it demonstrated a significant advantage in that the solution was trial independent. In actual field measurements, however, this form of SPECTRA may not be able to produce realistic answers. Several methods of discovering particularly bad data points or poor trial spectra are discussed for both UNSPEC and SPECTRA. Author (NSA)

N70-42821# Ohio State Univ. Research Foundation, Columbus.
PICTORIAL PATTERN RECOGNITION: AUTOMATIC INTERPRETATION AND CLASSIFICATION OF FINGERPRINTS Final Technical Report, 1 Oct. 1964–30 Sep. 1967
J. T. Tou and W. J. Hankley Apr. 1970 118 p refs
(Contract Nonr-495(29))
(AD-710415) Avail: NTIS CSCL 6/4

An approach is presented for automatic interpretation and classification of pictorial patterns in fingerprints which can be adequately characterized by their intensity boundaries. A specific scheme is developed, in detail, for application to single fingerprints, which are particularly suitable patterns in that they can be characterized as line patterns with very rich topological structure and essentially no other morphological features. Author (TAB)

N70-42888*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN MOS/LSI ANALOG-TO-DIGITAL CONVERTER
Owen Rowe, James J. Egan, and A. J. MacMillan *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 25–27 (See N70-42884 24-31)
Avail: NTIS CSCL 09B

The design and performance of a monolithic metal oxide semiconductor (MOS) analog-to-digital converter are described. The converter accepts input voltages of + or − 5 volts, has a 10-bit resolution including sign, operates at approximately 40 kHz, and utilizes MOS operational amplifiers. Author

N70-42889*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPUTER-AIDED DESIGN OF MOS/LSI ARRAYS
Carl E. Winkler *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 29–35 (See N70-42884 24-31)
Avail: NTIS CSCL 09B

To facilitate acquiring low volume LSI arrays from integrated circuit manufacturers and to minimize the turnaround time from design to circuit test, computer-aided design techniques are considered. A program of implementation is described. Author

N70-42890*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ADVANCED AEROSPACE COMPUTER TECHNOLOGY
Harrison Garrett *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 37–44 (See N70-42884 24-31)
Avail: NTIS CSCL 09B

The design and development of a family of advanced aerospace computers called the space ultrareliable modular computers (SUMC) is described. The computer development is being directed toward application on space missions in the 1975 to 1980 time frame. The SUMC advances the technology in computer design and logic implementation, and employs the latest technology in memory and power supply design. The unique functional features designed into the SUMC result in a high degree of flexibility; i.e., variable and sophisticated instruction set, modular word length, and the availability of numerous registers for arithmetic operations. Standardization was designed into the SUMC, and only eight different types of large scale integrated (LSI) chips are required to implement any one of the total family of advanced aerospace computers. This feature results in a lower manufacturing cost and it affords some reliability enhancement. Author

N70-42891*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MULTIPLEXED DATA BUS TECHNIQUES FOR ADVANCED AVIONICS SYSTEMS
W. O. Frost *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 45–48 (See N70-42884 24-31)
Avail: NTIS CSCL 09D

A significant fraction of the weight of a complex avionics system, such as that required for the space shuttle, is attributable to the wires connectors, and associated mounting hardware. To prevent such interconnections from becoming a disproportionately large fraction of the system size and weight, the merits of using multiplexing techniques for the transfer of data and command signals between the system elements were evaluated. Author

N70-42946# Mitre Corp., Bedford, Mass.
ANNOTATED MICROPROGRAMMING BIBLIOGRAPHY
Thomas P. Berschback Jul. 1970 73 p refs
(Contract F19628-68-C-0365)
(AD-709765; M69-65; ESD-TR-70-204) Avail: NTIS CSCL 9/2

The bibliography provides an indexed, annotated list of publications related to the field of microprogramming, from the introduction of the term in 1951 to the present time. Author (TAB)

N70-42954# Naval Ship Systems Command, Washington, D.C.
THE 7th ANNUAL TECHNICAL SYMPOSIUM: DEVELOPING A STATISTICALLY DESIGNED EXPERIMENT FOR COMPARING TECHNICAL MANUALS
Beatrice S. Orleans and Stanley Myers 1970 36 p
(AD-709388) Avail: NTIS CSCL 15/5

This paper briefly describes the differences in concepts between the Symbolic Integrated Maintenance Manual (SIMM) and the Conventional technical manual. It also summarizes past evaluations made by other activities and explains why evaluations must be properly planned according to statistical principles in order to come up with conclusions in which you can have confidence. The paper details the factors that must be considered in developing a designed experiment for evaluating the maintenance effectiveness of technical manuals. It also includes the essentials of the designed experiment developed by the Navy for the SIMM vs conventional manual comparison; this experiment will be adaptable, however, for use in comparing the effectiveness of any concepts in technical manuals. Author (TAB)

N70-42955# Sandia Corp., Albuquerque, N.Mex. Technical Libraries Div.
INPUT-OUTPUT SUPERVISOR [LE SUPERVISEUR D'ENTREE-SORTIE DANS LES ORDINATEURS]
Roger Dupuy
9 Jul. 1970 125 p refs Transl. into ENGLISH from French Report CEA-R-3860 Sponsored by AEC
(SC-T-70-4027; CEA-R-3860)

The techniques for managing peripherals in input–output supervisors are examined. Topics include transmissions, interrupts, software–hardware interface, system design, recognition and processing of interrupts, input/output control system (CES), tasks common to CES and RTI, conclusions on input–output supervisors, stacking requests or stacking interrupts, memory management, the different interrupt systems, and conclusions and outlook for the future. NSA

N70-43020# Naval Postgraduate School, Monterey, Calif.
A STUDY OF DIGITAL FILTERS
Philip Joseph Walsh (M.S. Thesis) Dec. 1969 128 p refs
(AD-710381) Avail: NTIS CSCL 9/5

The thesis discusses the subject of digital filters in two parts. First the analytical tools and synthesis techniques which are used for digital signal processors are explained and illustrated with examples. Emphasis is placed on (1) the generation and use of the digital transfer function, (2) design procedures in the frequency domain using methods of continuous-filter design as intermediate steps, and (3) real-time digital-filter implementation schemes. In the second part of the thesis a machine-language computer program is presented for the real-time simulation of digital filters on a hybrid computer. The program is described in detail and experimental results for several filter designs and realization schemes are reported. It is believed that such a computer program, with its inherent ability to accurately simulate a special-purpose computer and to provide external control of word length and clock frequency, could be used to experimentally determine specifications for the LSI implementation of digital filters. Author (TAB)

N70-43093# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
DIRECTORY CONSTRUCTION AND DECODING IN A GENERALIZED FILE STRUCTURE
Barbara M. Desiato Aug. 1970 72 p refs
(Contract N00014-67-A-0216-0014)
(AD-710387; Rept-71-05) Avail: NTIS CSCL 9/2

A generalized file structure consists of a file and its directory from which some of the existing file structures such as inverted, index-sequential, and multilist files can be derived and specialized. The directory acts as a reference for information within the file. It consists of keywords (i.e., attribute-value pairs) and addresses of records which are characterized by these keywords. The directory and its access routines simulate an associative memory in that records can be located in the file by merely providing the keywords which are associated with the records. The directory is initialized when the file is created and is updated for each addition of a keyword or a record to the file. For a given attribute, directory decoding can be done for one specific value or a range of values. Decoding involves the search of the keywords within the directory and the addresses of the records characterized by these keywords. Author (TAB)

N70-43103# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
A COMPUTER-CONTROLLED GRAPHICAL DISPLAY PROCESSOR
James Gerard Fiasconaro (M.S. Thesis) Jun. 1970 19 p refs
(Contracts F19628-69-C-0044; Nonr-4102(01))
(AD-710479; MAC-TR-71) Avail: NTIS CSCL 9/2

The report describes the design, construction and operation of a low-cost, relatively sophisticated display processor that can be used with a standard cathode-ray tube (CRT) monito to display computer-generated pictures. The design was based on the following desired characteristics. The display processor should be able to intensify any one of the 1024 X 1024 raster points of the 10 X 10 inch display area. It should be able to draw straight lines of arbitrary length (up to 1024 raster units along each coordinate). It should be able to display any of the 96 printable ASCII characters. And finally, it should provide two character sizes and eight intensity levels. Author (TAB)

N70-43118# Auburn Univ., Ala. Computer Center.
AUBURN PLOTTING SYSTEM
Thomas W. Litteuer Jun. 1970 29 p
(Contract DAAH01-68-C-0296; Proj. Themis)
(AD-710430; THEMIS-AU-T-10) Avail: NTIS CSCL 9/2

The report was written by the Auburn University Computer Center as a part of the documentation necessary for the plotting software developed primarily for THEMIS research use of Auburns 30 in. CALCOMP digital incremental plotter model number 663. It represents significant improvements over the standard plotting software. Author (TAB)

N70-43143* National Aeronautics and Space Administration, Washington, D.C.
THE NASTRAN PROGRAMMER'S MANUAL
Frank J. Douglas, ed. 1970 1514 p refs
(NASA-SP-223) Avail: COSMIC CSCL 09B

The NASTRAN computer program for the analysis of large complex structures is presented. The NASTRAN program has been designed according to two classes of criteria. The first class relates to functional requirements for the solution of an extremely wide range of large and complex problems in structural analysis with high accuracy and computational efficiency. These criteria are achieved by developing and incorporating the most advanced mathematical models and computational algorithms that have been proven in practice. The second class of criteria relates to the operational and organizational aspects of the program. These aspects are somewhat divorced from structural analysis itself, but are of equal importance in determining the usefulness and quality of the program. Author

N70-43199# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FACILITIES FOR ANALOG AND ANALOG-DIGITAL COMPUTER TECHNOLOGY Selected Articles
E. E. Schwartz et al 27 May 1970 35 p ref Transl. into ENGLISH from the publ. 'Sredstva Analogovoy i Analogo-Tsifrovoy'vychislitelnoy Tekhniki' Moscow, Izd-Vo Mashinostroyeniye, 1968 p 154–160 and 197–209
(AD-710261; FTD-HC-23-98-70) Avail: NTIS CSCL 9/2

Digital differential analyzers that use single-digit increments have been relatively slow machines unable, in many cases, to operate on the real-time basis. Potentialities of digital integrating computers (DIC) that use high-order Stieltjes integrating formulas are considered. Principles of synthesizing DICs with multi-digit increments (realization of Shannons equations) are examined, as are the extrapolation and interpolation (or iteration) processes used in integration. An analysis of quantization shows that a much higher accuracy of results are obtainable if the variables proper, rather than their increments, are quantized. A difference-quantized pattern, which simulates the Shannon equations, can serve as the basis for synthesizing DICs with a floating point; to this end, all variables have to be normalized. Such DICs would have a speed of operation exceeding that of differential analyzers by 2-3 orders, at only a moderate increase in equipment. This fact opens good prospects for using DICs in simulating complex dynamic systems on the real-time basis; DICs also seem suitable for navigation systems and control of fast industrial processes. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N70-41852*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONTACT RESISTANCE OF ELECTROPLATED FLAT CONDUCTOR CABLE CONDUCTORS
T. H. Wilkinson 15 Jul. 1970 13 p
(NASA-TM-X-64542) Avail: NTIS CSCL 09A

A series of tests were conducted to determine the contact resistances of gold-over-nickel-plated and nickel-plated flat conductor cable (FCC) conductors engaged with a specially prepared FCC receptacle. Three conductor specimens (gold-over-nickel plated, cleaned nicel plated, and uncleaned nickel plated, prepared on a premolded plug) were tested under room atmosphere conditions, under outside winter conditions, and after 500 mating and unmating cycles. These tests established that gold-over-nickel-plated contacts were the lowest in contact resistance, but nickel plated (cleaned) contacts were within the acceptable limits. Author

N70-41929* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLENOID CONSTRUCTION Patent
Rudolph Rust and Ronald M. Noble, inventors (to NASA) Issued 21 Feb. 1967 (Filed 24 Nov. 1964) 6 p Cl. 335-300 Sponsored by NASA
(NASA-Case-XNP-01951; US-Patent-3,305,810; US-Patent-Appl-SN-413862) Avail: US Patent Office CSCL 09A

A solenoid or electromagnet capable of producing magnetic field intensities up to 100 kilogauss is described. The device is cooled by water containing a corrosion inhibitor. The water flows through passageways located within each turn of the electromagnet coil and also flows through zero voltage gradient portions of the electromagnet to prevent power losses due to electrical conductivity. A plastic material capable of withstanding large internal stress and strain forces along it longitudinal axis is sandwiched between coil turns. The device is also designed to withstand large mechanical forces created by the intense magnetic field and by expansion and contraction due to heat. R.B.

N70-42060*# Monsanto Research Corp., St. Louis, Mo.
DESIGN AND FABRICATION OF GALLIUM PHOSPHIDE RECTIFIERS
Arnold S. Epstein Washington NASA Oct. 1970 65 p refs
(Contract NAS3-12972)
(NASA-CR-1673) Avail: NTIS CSCL 09A

High temperature gallium phosphide rectifiers were designed and fabricated which at 400 C can carry one-half ampere at about three volts. dc reverse voltage at 400 C is over 50 volts (75 volts peak inverse) at 5 milliamperes reverse current. The junctions were fabricated using a state of the art technique, namely, closed tube zinc diffusions. The applicability of another fabrication technique, a solid-solid diffusion technique, was demonstrated. GaP rectifiers with dc reverse voltages of 175 volts (240 volts, peak inverse) were obtained at 300 C, while the forward voltage drop noted with a half ampere forward current was 5.7 volts at 300 C. The exact nature of the electrical structure formed has not as yet been determined. Author

N70-42063*# Stanford Research Inst., Menlo Park, Calif.
LOW-TEMPERATURE THERMIONIC EMITTER Final Report, 9 Feb. 1968–8 Apr. 1970
A. Rosengreen and D. Nitzan 15 May 1970 51 p
(Contract NAS12-607)
(NASA-CR-114164; SRI - PYU-7147) Avail: NTIS CSCL 09A

The processes developed for fabrication of integrated vacuum circuits (IVCs) are described. A 1-bit shift register is discussed and analyzed graphically by dividing the circuit up in smaller test circuits consisting of an inverter, two inverters in cascade, and a NOR gate. Fabrication and testing of the circuits are discussed. Particular attention is paid to the emission of diodes and triodes in the reverse direction, which prevented the circuits from operating. It is suggested that this problem is associated with flow of molten barium along the metal films during the activation process. Data from life tests of dual triodes are presented. All coplanar triodes, with a few exceptions, have proved to have relatively short lives, although conventional triodes with cathodes made from the same mixture of triple carbonates and photoresistivity used for the IVCs have shown no deterioration after more that 12,000 hours. It is suggested that the problem is connected with a slow migration of barium from the cathode along the connecting films. Author

N70-42067# Joint Inst. for Nuclear Research, Dubna. Lab. of High Energy.
PULSE SHAPER TRIGGERING FROM FIXED PART OF THE PULSE AMPLITUDE OF THE PHOTOMULTIPLIER
L. Ondrish, S. V. Mukhin, S. V. Rikhivitskii, I. N. Semenyushkin, P. Horvath et al. 1970 15 p refs In RUSSIAN
(JINR-P13-5065) Avail: AEC Depository Libraries

A pulse shaper of a scintillation counter triggering from the fixed part (15%) of the pulse amplitude is described. The output pulse amplitude is equal to 1V at a resistance of 50 ohms and time duration of 15 nsec. By changing input amplitude from 0.15 to 9.00 V, a bias of the output amplitude less than + or − 100 psec is obtained. A time resolution of 160 psec was obtained by testing in a 5 GeV/c negative pion beam.
Author (NSA)

N70-42076# Joint Publications Research Service, Washington, D.C.
LOW-POWER PLANAR THYRISTOR OBTAINED BY THE TRIPLE SUCCESSIVE DIFFUSION METHOD
G. F. Belova et al. 16 Sep. 1970 7 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radioelektron. (Ukrainian SSR), v. 13, no. 5, 1970 p 620−624
(JPRS-51389) Avail: NTIS

The configuration and certain geometric dimensions of thyristors obtained by the triple successive diffusion method are presented with an investigation of their electric characteristics in the temperature range of −70 to +120 C. The results of measuring the static and dynamic parameters of the developed thyristor are discussed, and it is concluded that this method by comparison provides definite advantages.
E.M.C.

N70-42118*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FREQUENCY RESPONSES AND OTHER CHARACTERISTICS OF SIX FAST-DECAY PHOSPHORS APPLICABLE TO FLYING-SPOT SCANNERS
Charles A. Wagner Washington Oct. 1970 42 p refs
(NASA-TN-D-6036; H-609) Avail: NTIS CSCL 09A

The P-16, P-24, P-36, P-37, and P-SP phosphors are currently available in production cathode ray tubes; P-X42 is an experimental phosphor. A pulse test measured rise and decay times, and two scanning tests measured frequency responses. Screen noise, burn and aging resistance, and variation of light output as a function of electron beam dwell time were also measured. The frequency responses of P-16, P-37, and P-SP phosphors did not vary during the tests. The frequency response of P-36 phosphor varied with electron beam dwell time, and the frequency response of P-24 phosphor varied with both dwell time and beam current. The bandwidths (frequencies at which the gain is 0.1) were as follows: P-16, 22 megahertz; P-24, 12 megahertz; P-36, 12 megahertz; P-37, 34 megahertz; P-SP, 21 megahertz. The bandwidth of P-X42 phosphor was estimated to be in excess of 100 megahertz. However, this phosphor produced relatively little light and had a screen that was too noisy to be useful in flying spot scanners.
Author

N70-42130# National Bureau of Standards, Washington, D.C. Physical Chemistry Div.
IMPROVEMENTS IN OSCILLOSCOPIC MEASUREMENTS IN HIGH-SPEED EXPERIMENTS
A. Cezairliyan, M. S. Morse, and H. A. Berman Oct. 1970 22 p refs
(NBS-TN-539) Avail: SOD $0.30

Refinements in oscilloscopic recording were made which improve the recording of isolated events in heavy current discharge studies, where substantially rectangular pulses are employed. The accuracy of the method employed was verified experimentally to be in the region of 0.01 to 0.1 percent. The first refinement is a unit for the differential suppression of the incoming signal by an adjustable amount, and the second refinement is a system by which time markers are sent to several oscilloscopes at adjustable time intervals simultaneously with the actual incoming signal.
Author

N70-42163*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SPLIT RANGE TRANSDUCER Patent Application
Tom D. Finely, inventor (to NASA) Filed 31 Dec. 1969 7 p
(NASA-Case-XLA-11189; US-Patent-Appl-SN-889375) Avail: NTIS CSCL 14B

A nonlinear circuit is connected to the output of a current-producing transducer to form a split-range transducer. In the range where most of the data to be measured is expected, the resolution is high and in the other range the resolution is lower.
NASA

N70-42248# Air Force Cambridge Research Labs., Bedford, Mass.
THE FIVE METER MILLIMETER SPHERICAL ANTENNA
P. M. Geruni Apr. 1970 23 p refs Transl. into ENGLISH from Antenny (USSR), no. 4, 1968 p 3−15
(AD-709358; AFCRL-70-0278; AFCRL-TRANS-80) Avail: NTIS CSCL 9/5

The basic parameters for the spherical two-reflector antenna are set forth. This antenna operates in the millimeter and centimeter ranges and the main fixed reflector has a diameter of about 5 m. A justification is given for the selection of the parameters and data are presented on the design and construction. Information is given on the spatial orientation, the automatic control system, and the radiometer. Certain results are given of the experimental investigation of the antenna and of temperature measurements of the sun and moon at a wavelength of 8 mm.
Author (TAB)

N70-42349*# Spacetac, Inc., Cambridge, Mass. Microtek Div.
RELIABILITY STUDIES OF THICK FILM COMPONENTS Final Report
Maynard S. Renner 19 Jun. 1970 158 p
(Contract NAS12-2122)
(NASA-CR-110782) Avail: NTIS CSCL 09A

The effect of material, design, and processing variables upon the performance characteristics of thick film products (resistors, capacitors, and conductors) are reviewed. Statistical results are also included of the resistor stability tests.
Author

N70-42410 National Lending Library for Science and Technology, Boston Spa (England).
ON SOME LINEAR TRANSFORMATIONS OF THE DIFFERENTIAL EQUATIONS OF ac ELECTRICAL MACHINES [O NEKOTORYKH LINEINYKH PREOBRAZOVANIYAKH DIFFERENTSIAL' NYKH URAVNENII ELEKTRICHESKIKH MASHIN PEREMENNOGO TOKA]
V. Ya. Bespalov 1970 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Elektromekh. (USSR), v. 11, 1967 p 1229−1236
(NLL-RTS-5795) Avail: Natl. Lending Library, Boston Spa, Engl.: 20s; 3 NLL photocopy coupons

A mathematical discussion is presented showing that the differential equations representing electric motors possess the properties of additivity and holonomy for a variable rotor speed and that they can be regarded as quasi-linear. The method of symmetrical components, Fourier harmonic analysis, and other linear transformations are applied to the equations, and the question of linearity is considered. The problem is arranged for solution with a digital computer.
N.E.N.

N70-42441 Northwestern Univ., Evanston, Ill.
DESIGN OF UNIVERSAL LOGIC MODULES
Miljenko Orsic (Ph.D. Thesis) 1969 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-134

Progress in manufacturing technology of integrated circuits has motivated the increasing interest in the design of logic circuit which can realize any given logic function of up to a fixed number of variables. This circuit is generally known as the universal logic module (ULM). The function-selection mechanism of the ULM is assumed to be wholly external to the functional logic of the module. In current studies the complexity of the ULM is measured by the number of its input and output terminals (pins). Under this assumption, the problem considered is the design of ULM's with minimum or near minimum number of input terminals. The number of output terminals is assumed to be equal to the number of functions realized by the ULM simultaneously. Furthermore, the minimization of the ULM logic is considered. Testing and repair procedure is also discussed. It is assumed that the ULM is realized in a single integrated circuit package. . . . Dissert. Abstr.

N70-42486# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A NONLINEAR ANALYSIS OF THE CONTROL PARAMETER OF THE xi TRIGGERING OF AN IGFET COMPLEMENTARY MULTIVIBRATOR
Joseph F. Leblanc (M.S. Thesis) Mar. 1970 75 p refs
(AD-710601; GE/EE/70-16) Avail: NTIS CSCL 9/5

A nonlinear graphical method is used to evaluate the dynamic operating behaviour of a complementary IGFET switching circuit when triggered with the control parameter, in contradistinction to the conventional method of shifting the load line. In the analysis, the minimum-amplitude pulse for guaranteed switching was determined for both ramp functions and step functions. Also, output waveforms were constructed by reducing modified phase plane trajectories to true phase plane curves, and their waveshapes, amplitudes and period were evaluated for different ratios of capacitance to inductance. Author (TAB)

N70-42495# Utrecht State Univ. (Netherlands).
ELECTRON MULTIPLIER RESPONSE UNDER POSITIVE ION IMPACT
Maarten Van Gorkom (Ph.D. Thesis—Utrecht Univ.) May 1970 84 p refs
Avail: NTIS

To study aspects of electron multiplier response under standard mass spectrometer detection conditions, the secondary electron emission coefficients and pulseheight spectra were obtained for a variety of monatomic, diatomic and polyatomic positive ions impinging with 2 to 10 keV kinetic energy on the CuBe cathode of a conventional multiplier. Emission changes due to dynode surface conditions were eliminated by referencing all emission coefficients to the electron yield of neon. These relative emission coefficients were sufficiently reproducible to permit detector discriminatory effects to be studied over an extended period of time. . . . ESRO

N70-42505# Signals Research and Development Establishment, Christchurch (England).
A MODULATOR AS A CUSTOMER DESIGNED SILICON INTEGRATED CIRCUIT
C. H. Jones Mar. 1970 28 p refs
(SRDE-70022) Avail: NTIS

The development of a complex analog circuit suitable for production on a single silicon chip is described. The circuit was produced to a close specification for external supplies and signals as well as working over a wide temperature range. The number of external components were kept to a minimum with the microphone input fed via a blocking capacitor and a further capacitor added to reduce the audio gain at high frequencies. One external resistor has to be adjusted on test to set the audio dc levels applied to the modulator. . . . Author (ESRO)

N70-42550# Lincoln Lab., Mass. Inst. of Tech., Lexington.
HIGH-EFFICIENCY MODES IN AVALANCHE DIODES
Henry Berger and Richard J. Sasiela 3 Aug. 1970 13 p refs
(Contract AF 19(628)-5167)
(AD-710201; TN-1970-19; ESD-TR-70-230) Avail: NTIS CSCL 9/1

Some recent experimental results on a high-efficiency mode in avalanche diodes are not explained by the results to date of TRAPATT mode theory despite careful and comprehensive modeling. The note explores one aspect of large-signal theory not previously examined in the literature, suggesting one reason for the above situation. An explicit third boundary condition (in addition to the conventional two boundary conditions) involving the diode-circuit interaction is presented which does not appear in the prior literature. Author (TAB)

N70-42577*# General Electric Co., Schenectady, N.Y.
DEVELOPMENT AND ENDURANCE TESTING OF HIGH-TEMPERATURE CERAMIC RECTIFIERS AND THYRATRONS
N. D. Jones Washington NASA Oct. 1970 59 p refs
(Contract NAS3-8525)
(NASA-CR-1684) Avail: NTIS CSCL 09A

The long term performance capability of gas filled ceramic rectifiers and thyratrons was evaluated in a high temperature, high vacuum environment. The thyratron design utilized was based on investigations conducted earlier. The feasibility of operating these thyratrons at wall temperatures of 650 to 750 C at 3200 Hertz with 2,000 peak forward and inverse volts, and at 15 average amperes, was demonstrated for periods exceeding 10,000 hours. Author

N70-42605 Illinois Univ., Urbana.
THE POINT CONTACT, ELECTRIC-TUNNELING, SUBMILLIMETER WAVELENGTH DETECTOR
Samuel Isaac Green (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 70-862

The electrical characteristics of the detector were studied extensively in the search for the detection mechanism. The current-voltage characteristic curves and the behavior of responsivity (detected output voltage per watt of incident microwave power) with bias, frequency, and power level are presented in detail. The current-voltage curves are shown to contain a quadratic term in voltage to which zero bias detection is attributed. The frequency response remains constant well into the millimeter wavelength region where it begins to deteriorate at 6 db/octave due to the resistance-capacitance product of the detector. The polarity of detected output reverses at high levels of applied microwave power. Scanning electron microscope photos of used and unused whisker tips are studied to determine the actual contact geometry. The physical model of electric tunneling through a thin asymmetrical potential barrier is proposed as the detection mechanism. Dissert. Abstr.

N70-42613# General Dynamics/Convair, San Diego, Calif.
ELECTRODE EROSION IN HIGH CURRENT ELECTRIC ARCS Final Report
K. T. Shih Wright-Patterson AFB, Ohio AFL Jun. 1970 70 p refs
(Contract F33615-67-C-1386)
(AD-709889; AFL-70-0077) Avail: NTIS CSCL 20/3

Methods were developed to measure the anode heat flux and current densities of high-current-pulsed arcs. The heat flux

density was determined by measuring the time from striking an arc to the onset of surface melting. Data was taken using argon and nitrogen with different metals and pressures. The anode heat flux density was found to be between 10,000 to 1,000,000 W/sq cm for arc currents of 50 to 2000 amps; these values increased with increasing arc current and gas pressure and were higher in nitrogen than in argon. The current density was measured by a split anode. The maximum current density was found to be 55000 A/sq cm in air at atmospheric pressure, a current of 1200 amps. The surface conditions were found to have a strong effect on anode erosion. In addition, high-speed movie pictures were used to study the arc and its erosion spot. Author (TAB)

N70-42635 Polytechnic Inst. of Brooklyn, N.Y.
ON SOME ASPECTS OF ARRAY MATCHED FILTERING
Martin E. Somin (Ph.D. Thesis) 1969 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-17802

Some aspects of the problem, when the signals are generated by a far field point source and the additive noise is principally generated by spatially localized far field distributions of noise sources, are considered. Implementations of both fixed design and adaptive matched filters for such situations are analyzed. The design of fixed filters is formulated in terms of a priori knowledge of the coherence properties of the far field sources which generate the noise field at the array. For spatially localized sources the resultant matched filtering operation is shown to often have an interpretation consisting of delay line steerers dependent on the problem geometry and a data transformation dependent on the noise source coherence properties. An adaptive array matched filter of sufficient simplicity for real time implementation is also derived. In addition it is shown that under certain conditions the bounds on system performance with hard limited input data take a similar form to that for unclipped Gaussian noise. Dissert. Abstr.

N70-42643# Office of Research Analyses, Holloman AFB, N.Mex.
AN ANALYSIS OF A DISC MOUNTED MONOPOLE ANTENNA ABOVE A FLAT CONDUCTING PLANE Final Special Report
Calvin W. Thomas (Ph.D. Thesis) Jun. 1970 247 p refs
(AD-709871; ORA-70-0010) Avail: NTIS CSCL 9/5

The problem of determining the impedance at the base of a thin wire antenna erected vertically above the center of a circular disc above the surface of a horizontal ground plane is considered in detail. The general problem is formulated in terms of a set of dual integral equations for the weighting function of the radial component of the electric field in the plane of the disk. The integral equations are solved for the case of the antenna in free space by reducing the equations to an infinite array of simultaneous algebraic equations and using an iterative technique to compute the coefficients of the weighting function. The general problem is then formulated in terms of the known solution in free space and the reflection coefficient subject to the secondary reflection from the disc being small. Solutions for the case of this antenna in free space and for relative large earth-disc separations have been developed for the impedance and numerical results have been obtained for special cases. The general problem of determining the effect of the horizontal ground plane on the antenna is formulated and discussed in terms of the assumption necessary to obtain a solution. Author (TAB)

N70-42661# Battelle Inst., Frankfurt am Main (West Germany).
HETEROJUNCTION DIODES AS A BASIS FOR THE DEVELOPMENT OF NEW SEMICONDUCTOR DEVICES
Dieter Bonnet and Helmut Rabenhorst *In its* Battelle Inform. No. 4 Apr. 1969 p 5–10 refs (See N70-42660 24-34)
Avail: NTIS

Heterojunction diodes consist of semiconductor materials of non-uniform chemical composition which change the normal energy band model of the p-n junction, and give rise to a varying energy gap at the interface. Their fabrication and examples of several applications are discussed. These diodes should lead to substantial improvements in the efficiency, output, upper frequency limit, etc. of many semiconductor devices. ESRO

N70-42663*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXTREME TEMPERATURE REQUIREMENTS FOR SPACECRAFT ELECTRONICS PARTS FY 1971 THE ORBITER CASE
Jerry Swanson 15 Sep. 1970 34 p refs
(Contract NAS7-100)
(NASA-CR-110783; JPL-750-39) Avail: NTIS CSCL 09E

The data obtained are used to evaluate the capability of existing parts and serve as design criteria for new parts. The orbiter investigation is centered on a hypothetical spacecraft which may be instrumented for an orbiter mission around any of the planets. For the inner planet orbiters, high temperature extremes may occur either while orbiting Venus or Mercury, depending upon the distance of the spacecraft from the planet's surface. Orbits around each planet are examined to determine the worst case effects. The worst case low temperature extremes incurred by an orbiting spacecraft may be expected to occur during orbiting of Pluto. Studies indicate that by proper design temperature extremes can be limited to occur only at locations on orbiter spacecraft remote from the main bus. The types of electronic components contained in units at these remote locations are identified, and thermal studies are performed to determine the severity of temperatures resulting from the thermal variations in the environment. Power and weight penalties resulting from the use of various means of thermal control are evaluated and summarized. Author

N70-42702*# Michigan Univ., Ann Arbor. Electron Physics Lab.
HYDRODYNAMIC ANALYSIS OF NOISE IN A FINITE-TEMPERATURE ELECTRON BEAM
H. C. Hsieh *In its* An Invest. of Nonlinear Interaction Phenomena in the Ionosphere Nov. 1969 8 p refs Repr. from J. Appl. Phys., v. 36, no. 8, Aug. 1965 p 2414–2421 refs (See N70-42701 24-13)
(Contract AF 30(602)-3569)
Copyright. Avail: NTIS CSCL 20G

On the basis of a small-signal, one-dimensional analysis, a set of basic macroscopic differential equations, governing the fluctuations in quantities such as the electron-beam temperature, the mean velocity, and the current density, was derived by taking moments of the Liouville equation with respect to the velocity variable. This set of differential equations expresses the conservations of charge, momentum , and energy, and is valid for an arbitrary amount of velocity spreading and includes the effect of heat conduction. A system of differential equations, governing the correlation among the fluctuations in the mean velocity, current density, and beam temperature, is also derived. The relationship among the various noise parameters along the electron beam is obtained in the form of a system of differential equations whose solution gives detailed information on the variation of the noise-figure parameter along the beam. The solution of the system of differential equations thus derived is also discussed. Author

N70-42850# Naval Research Lab., Washington, D.C. Satellite Communication Branch.
THE NRL MICROWAVE SPACE RESEARCH FACILITY OPERATING PROCEDURES OF THE COMPUTER CONTROL SYSTEM FOR THE 60 ft X-BAND ANTENNA Final Report
C. A. Bass and D. H. Townsend 30 Jun. 1970 69 p refs
(AD-710368; NRL-7110) Avail: NTIS CSCL 9/5

In its primary mode of operation the 60-ft X-band antenna at NRLs Microwave Space Research Facility is positioned by means of a digital control system, the Navy Antenna Computer Tracking and Command (NACTAC) system. Both hardware design and software programming of the NACTAC system are operator oriented with respect to the manner in which requirements are defined and control is exercised. System operating procedures are described in detail. They include computer startup, loading of the NACTAC system program, computer-operator dialogues for entering NACTAC source data, operator-designated selections available from the main control console, NACTAC diagnostics, data card formats, and computer shutdown procedures. Author (TAB)

N70-42886*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DEVELOPMENT OF TRIMMING TECHNIQUES FOR MICROCIRCUIT THICK-FILM AND THIN-FILM RESISTORS

S. V. Caruso and R. V. Allen *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 5–12 (See N70-42884 24-31)

Avail: NTIS CSCL 09E

Thick-film and thin-film resistors contained in hybrid microcircuits normally require adjustment for precision tolerances of + or − 1 percent or better. Current trimming techniques were evaluated and are discussed. The air-abrasive method was determined to be best for thick films. Laser trimming and ultrasonic trimming were found to be most successful with thin films. A hybrid microelectronic development program and resistor trimming results are presented. Author

N70-42887*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DEVELOPMENT AND FABRICATION OF A MICROELECTRONIC CONTROL ACCELEROMETER SYSTEM

R. V. Allen, S. V. Caruso, G. L. Filip, and R. F. De Haye *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 13–23 (See N70-42844 24-31)

Avail: NTIS CSCL 09E

A flight control accelerometer used on the Saturn 1B vehicle was redesigned and packaged using hybrid microcircuit technology. Though there is currently no requirement for use of this control accelerometer on the Saturn V vehicles, the design, fabrication, and packaging of this system has proven the feasibility of such applications. Author

N70-42892*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

RELIABILITY EVALUATION OF BIPOLAR LSI MICROCIRCUITS

Leon Hamiter and Federico Laracuente *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 49–57 (See N70-42884 24-31)

Avail: NTIS CSCL 09E

Bipolar large scale integrated (LSI) circuits constructed with multilevel molybdenum-gold metallization were evaluated to identify and understand design and manufacturing weaknesses typical of these circuits, to determine their actual or most probable failure mechanisms, and to develop quality standards and screening criteria for the circuits. The circuits tested were transistor-transistor logic built on a 3.175 cm (1.25 in.) silicon wafer and packaged in a 158-lead ceramic, glass, and metal package. Their functional configuration included logic gates, flip-flops, and shift registers. Author

N70-42893*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MICROCIRCUITS, 10- TO 15-YEAR SPACE MISSIONS

M. F. Nowakowski and F. Villella *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 59–63 refs (See N70-42884 24-31)

Avail: NTIS CSCL 09E

The technology necessary to determine whether microcircuits will satisfy performance requirements for 10- to 15-year space missions is discussed. Large scale integration/medium scale integration techniques are reviewed, and the advantage of system reliability in keeping circuit complexity within a single silicon chip or wafer to function as an electronic system or subsystem is discussed. Redundancy, radiation tolerant devices, and rigorous in-process control and screening tests are also discussed with particular emphasis on how a microcircuit shall be done to assure the successful accomplishment of these missions. Author

N70-42944# Standard Electrik Lorenz A. G., Stuttgart (West Germany). Zentrallabor.

TANTALUM THIN-FILM CIRCUITS FOR SPACEFLIGHT APPLICATIONS [TANTAL-DUENNSCHICHTKREISE FUER RAUMFLUGANWENDUNG]

H. Lauckner and R. Rossberg Jun. 1970 79 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.

(BMBW-FB-W-70-32) Avail: NTIS; ZLDI Munich: 16,20 DM

The manufacture of high-accuracy tantalum thin-film resistor circuits with substantially reduced dimensions is described. They can be combined with semiconductors in flat packs and sealed to form modules. Detailed instructions are given for such circuits intended for space applications. An advanced etching process produces resistive paths as narrow as 25 micrometers having resistances of 2.5 megaohms/sq cm. Resistance adjustments to within 0.1% are also described. Author (ESRO)

N70-42964# Honeywell, Inc., Minneapolis, Minn.

MULTIFORMAT ELECTROLUMINESCENT DISPLAY

J. D. Kopecky JANAIR 31 Jan. 1970 143 p refs

(Contract N00014-69-C-0349)

(AD-710421; JANAIR-700306; Rept-21206-FR) Avail: NTIS CSCL 9/5

The objective of the program was to demonstrate the utility of Thin Film Electroluminescence (TFEL) as a display media through mechanization of three demonstrators. Each demonstrator has a different display format typical of potential applications of this media for airborne displays. The display formats mechanized were (1) dual bargraph, (2) flight control (docker), and (3) warning annunciator. Each unit was designed, constructed, tested, and packaged as a portable, self-contained demonstrator. A preliminary proposed technical approach for evaluation of displays within military aircraft was also prepared. Author (TAB)

N70-43016# Naval Research Lab., Washington, D.C. Signal Processing Branch.

SMOOTH LIMITING OF TWO SIGNALS IN A NARROWBAND SYSTEM Final Report

J. S. Lee and J. H. Hughen 15 Jul. 1970 25 p refs

(AD-710389; NRL-7113) Avail: NTIS CSCL 9/5

The performance of a bandpass smooth limiter which is represented by the error function is analyzed when the input is a sum of two signals. Two input cases are considered: sine wave plus sine wave and sine wave plus narrowband Gaussian noise. Corresponding to various input ratios, output ratios of inband signals are obtained and displayed graphically as a function of a parameter q which specifies the degree of the limiter hardness relative to the input level. One of the graphic results is the behavior of the captured limiter as the limiter hardness is decreased. The error function characterization of the limiter is believed to be realistic since it is capable of describing a wide range of practical operating characteristics of limiters and saturated amplifiers. In the limit, when q = 0, the smooth limiter becomes a linear amplifier, and the limit where q = infinity corresponds to an ideal hard limiter. The results corresponding to q = infinity are shown to agree with those known for the ideal hard limiter. Author (TAB)

N70-43029# Army Electronics Command, Fort Monmouth, N.J.
DOUBLE-COUPLED HELIX TRAVELING-WAVE TUBE WITH A TRANSVERSELY-MAGNETIZED GYROMAGNETIC MATERIAL
Louis J. Jasper, Jr. Jul. 1970 65 p refs
(AD-710238; ECOM-3304) Avail: NTIS CSCL 9/1

An analysis is presented, using concentric coupled helices with a gyromagnetic material (ferrite) magnetized transverse to the direction of propagation and located inside the inner helix. The field theory approach is used in treating the problem and the results are expressed as slow-wave solutions. Qualitative and quantitative results are presented in the form of equations and graphs. Maxwells equations are solved subject to the boundary conditions of helically conducting cylindrical sheaths. The electromagnetic (EM) field equations and coefficients, transcendental equation and impedances are given. Qualitative results in the form of graphs illustrate wave propagation and impedance characteristics, resonance and nonreciprocal effects, and electric field configurations for typical values of the ferrite parameters. Some important aspects of ferrite are pointed out which illustrate the use of gyromagnetic materials in traveling-wave tubes. Author (TAB)

N70-43054# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SWITCHING-DIODE CLOCK-PULSE GENERATOR CPG TO SUPPLY THREE-CLOCK-CYCLE MAGNETIC LOGIC ELEMENTS
S. T. Kovenko et al 27 May 1970 12 p Transl. into ENGLISH from 11th All-Union Conf. on Magnetic Elem. for Automation and Computer Technol. (Tallin), 1966 p 189 – 193
(AD-710269; FTD-HC-23-118-70) Avail: NTIS CSCL 9/5

A clock-pulse generator (CPG) designed with D227I pnpn diodes is described; its ability to preserve information in the computer on temporary loss of power distinguishes it fro2 other known CPGs. The new CPG comprises: a master unit which is a closed-loop shift register designed with pulse transformers; an output switch unit consisting of three working and three compensating switches (each switch is a relaxation oscillator designed with 5 series-connected pnpn diodes); an emergency-start unit which is intended for starting the CPG during alignment operations or on a break in one of the magnetic-logic-element channels. A principal connection diagram of the CPG is explained. The CPG can supply up to 1000 magnetic logic elements at 3.5 kHz. The CPG was in operation for four months; no malfunction occurred for 750 hrs of its actual work. TAB

N70-43060# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A SIGNAL PROCESSING PULSE WIDTH DISCRIMINATOR
Cecil L. Wilson and Marcus G. Stansbury Jun. 1970 15 p
(AD-710230; BRL-MR-2040) Avail: NTIS CSCL 9/5

A radiometer output contains noise and background pulses as well as target pulses. Analysis has determined the average pulse length of target signals. This pulse length discriminator is a device which determines the length of pulse signals which are acceptable and rejects those which are longer or shorter than target signals. A description of the equipment and a discussion of the results are included. Author (TAB)

N70-43078# Lehigh Univ., Bethlehem, Pa.
[DIODE PERFORMANCE AND MICROWAVE NOISE MEASURING SYSTEM] Final Technical Report
30 Jun. 1970 66 p refs
(Grant DA-AMC-28-043-68-G-7)
(AD-710304) Avail: NTIS CSCL 9/1

The report covers work done during the past grant period, which included studies of the performance of wide silicon p-i-n diodes and IMPATT diode oscillators, and the development of a microwave noise measuring system. Chapter 1 describes observations of unusual properties of wide p-i-n diodes with respect to transmission of microsecond and submicrosecond pulses and VHF sinusoidal signals. Champter 2 presents a theoretical analysis of the noise generated by a Read diode IMPATT oscillator in the presence of a small but not negligible signal current. The analysis points to a possible method of accounting for nise output in the neighborhood of the signal frequency of such an oscillator. Chapter 3 describes a microwave noise measuring system which is used to measure AM and FM noise spectra of oscillators. Measurement results are given. Author (TAB)

N70-43080*# Texas A&M Univ., College Station. Remote Sensing Center.
PASSIVE MICROWAVE SENSING OF THE EARTH'S ENVIRONMENT: A BIBLIOGRAPHY WITH ABSTRACTS
Jerry A. Richerson, comp. Sep. 1969 45 p refs
(Grant NGL-44-001-001)
(NASA-CR-110864; RSC-03) Avail: NTIS CSCL 09E

A collection of articles on the topic of passive microwave sensors is presented. The main emphasis of the bibliography is on the application of passive remote sensing in the microwave region and the interpretation of the results. Some articles on the theory of operation of the equipment and the theory of radiation by certain bodies are included to give a background for the study of applications of passive radiometry. A bibliography covering atmospheric absorption and attenuation of microwaves is included. The bibliography is divided into three sections. First is a listing of books and symposium proceedings. The books give the general theoretical aspects of microwave radiometry. The listing of symposium proceedings in this division is for the purpose of providing information to aid in the location of these publications. Their basic topic is the application of passive microwave systems. Second is a listing of articles covering the topic of passive microwave sensors. The emphasis of this section is on the application of microwave sensors, but some theory on microwave emission and factors effecting the microwave noise level is also included. In this section an abstract of each article is included. The final listing is a representation of articles concerning microwave absorption and attenuation. Author

N70-43098# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LI-419 VIDICON WITH ELECTROSTATIC FOCUSING AND MAGNETIC DEFLECTION
Ya. Ya. Vende et al 5 Jun. 1970 12 p refs Transl. into ENGLISH from Tekhn. Kino i Televideniya (Moscow), v. 13, no. 11, 1969 p 61 – 63
(AD-710253; FTD-HT-23-276-70) Avail: NTIS CSCL 9/1

The article deals with an LI-419 vidicon which has a single lens electrostatic focusing system of three successively arranged axisymmetric cylindrical electrodes and other desireable features which are an improvement over the presently-used vidicons with magnetic beam control. Author (TAB)

N70-43102*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RF VOLTAGE BREAKDOWN IN COAXIAL TRANSMISSION LINES Final Report
R. Woo 1 Oct. 1970 41 p refs
(Contract NAS7-100)
(NASA-CR-110935; JPL-TR-32-1500) Avail: NTIS CSCL 09A

Results are summarized of extensive studies of RF voltage breakdown, investigated because of its occurrence in components designed for operation in space. Using the principle of similarity and a minimum of experimental data, universal curves are constructed covering a wide range of experimental parameters. These data are sufficient to determine the power handling capability of any coaxial transmission lines likely to be encountered by a spacecraft design engineer. Author

N70-43115# Naval Research Lab., Washington, D.C. Microwave Techniques Branch.
AN ITERATIVE TECHNIQUE FOR REDUCING SIDELOBES OF CIRCULAR AND CYLINDRICAL ARRAYS Interim Report
H. P. Coleman 22 Jun. 1970 17 p refs
(AD-710360; NRL-7086) Avail: NTIS CSCL 9/5

An iterative technique which allows the computation of low sidelobe current distributions for circular and cylindrical arrays, was developed and computer implemented. The method is described, and examples are shown of its use in calculating current distributions for circular arrays of 32 axial dipoles with half-wavelength element spacing. For such arrays of 20 elements azimuth directivities only 0.5 dB less than the directivity of an order-Q Tchebycheff pattern with the same sidelobe level were obtained. Author (TAB)

N70-43157+ British Broadcasting Corp., Kingswood (England). Research Dept.
THE CHOICE OF PRIMARY COLOURS FOR COLOUR TELEVISION
C. B. B. Wood 1970 9 p refs
(Rept-1970/32) Avail: NTIS

The selection of primary colors for color television is discussed. The chromaticities of the color phosphors used in the receiver display tube are a fundamental part of the specification of a color television system and the colorimetric design of a camera or film scanner cannot be undertaken without this knowledge. The recommendations leading to changes in receiver chromaticities are presented. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N70-41949*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
METALLIC INTRUSION DETECTOR SYSTEM Patent Application
Robert D. Lee, inventor (to NASA) FILED 18 Aug. 1970 23 p
(NASA-Case-ARC-10265-1; US-Patent-Appl-SN-64709) Avail: NTIS CSCL 09E

A system is described for determining the intrusion, relative size, and the physical characteristics of a metallic object in a predetermined space. Transmitter and receiver coil assemblies are arranged to define a space through which a metallic object is expected to pass. The assemblies are adapted to generate an electromagnetic field of predetermined energy per unit volume, with the receiver coil coupled to the energy source to indicate the intrusion of a metallic object into the electromagnetic field, whether the object is ferrous or nonferrous, and the size of the object. NASA

N70-41964* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VARIABLE TIME CONSTANT SMOOTHING CIRCUIT Patent
Raymond George Hartenstein, inventor (to NASA) Issued 21 Feb. 1967 (Filed 6 Aug. 1964) 4 p Cl. 333-79
(NASA-Case-XGS-01983; US-Patent-3,305,801; US-Patent-Appl-SN-388023) Avail: US Patent Office CSCL 09C

A smoothing network which operates over a wide frequency range for the removal of noise from pulse chains and which has a fast rise time is described. The network incorporates a nonlinear circuit in series with a capacitor element. The input is connected across the series network, and the output is taken across the capacitor element. An example of a usable nonlinear circuit is a pair of diodes connected in parallel in a back-to-back relationship. The smoothing network described is applicable to pulse modulated telemetry receivers and transponders used in space vehicles and in earth based equipment. P.A.B.

N70-41966*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
ELECTRONIC VIDEO EDITOR Patent Application
Darrow L. Webb, inventor (to NASA) Filed 4 Aug. 1970 16 p
(NASA-Case-KSC-10003; US-Patent-Appl-SN-60883) Avail: NTIS CSCL 09E

An electronic video editor for switching any one of a plurality of video input signals to a common output channel is described. The switching operation is manually initiated and electronically controlled so that the switching from one video input signal to another takes place during the blanking portion of the signal in order that frames of the picture are not lost. NASA

N70-41991* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BASELINE STABILIZATION SYSTEM FOR IONIZATION DETECTOR Patent
J. Howard Marshall, inventor (to NASA) Issued 23 May 1967 (Filed 18 Sep. 1964) 4 p Cl. 250-83.6 Sponsored by NASA
(NASA-Case-XNP-03128; US-Patent-3,321,628; US-Patent-Appl-SN-397665) Avail: US Patent Office CSCL 09E

An arrangement is described which automatically stabilizes the baseline current of the output of an ionization detector used in a gas chromatograph. The effects of the quiescent current or drift of the detector are substantially eliminated. The output is sampled just prior to taking a measurement and then is stored on a capacitor. The output of the capacitor is used to provide a nulling current during the time in which the detector is providing readings for the chromatogram. P.A.B.

N70-42021*# M&S Computing, Inc., Huntsville, Ala.
BANNING DESIGN AUTOMATION SOFTWARE IMPLEMENTATION Interim Report
K. H. Schonrock 30 Jun. 1970 38 p refs
(Contract NAS8-25621)
(NASA-CR-102841; M/S-70-0020) Avail: NTIS

The development and implementation of each software component of the system to allow automatic design of MOS-FET circuits are described. The components of the system are the artwork program to generate commands for drawing the required arrays; the placement, routing, and folding program to place the individual circuit cells on a chip area; the display support software package to provide specialized and general display services; and the quick look feature to provide an application program test bed. The specific developmental progress in each area, along with the major problems encountered, is described, and program questions and answers are included. N.E.N.

N70-42032* Douglas Aircraft Co., Inc., Santa Monica, Calif.
SWITCHING CIRCUIT EMPLOYING REGENERATIVELY CONNECTED COMPLEMENTARY TRANSISTORS Patent
Spencer R. Shortridge, inventor (to NASA) Issued 23 May 1967 (Filed 25 Feb. 1965) 6 p Cl. 307-88.5 Sponsored by NASA
(NASA-Case-XNP-02654; US-Patent-3,321,645; US-Patent-Appl-SN-435387) Avail: US Patent Office CSCL 09E

A transistorized trigger circuit is described which nearly eliminates power consumption when the circuit is not actually operated. A control circuit with a pair of complementary, n-p-n and p-n-p, transistors is coupled between an output terminal or load and

a single source of positive operating potential so that regenerative conductivity may establish current flow to provide voltage steps at the output terminal when the current is interrupted. A third, n-p-n, transistor initiates and interrupts the current flow through the pair of transistors. N.E.N.

N70-42068# Paris Univ., Orsay (France). Faculty of Sciences.
STUDY OF THE PROPAGATION OF ELECTROMAGNETIC WAVES ALONG HELICOIDAL CONDUCTORS. INFLUENCE OF THICKNESS OF THE WIRE ON THE PHASE VELOCITY [ETUDE DE LA PROPAGATION D'ONDES ELECTROMAGNETIQUES LE LONG DE CONDUCTEURS HELICOIDAUX. INFLUENCE DE L'EPAISSEUR DU FIL SUR LA VITESSE DE PHASE]
J. Crouzet (Ph.D. Thesis) 18 Feb. 1970 140 p refs In FRENCH
(NP-18201) Avail: AEC Depository Libraries

The phase velocity of the electromagnetic wave circulating on a helical wire is studied from the viewpoint of using the helicoidal structure as a low energy proton linear accelerator. A systematic study was made of the effect of the radius r sub 0 of a conductor wire coiled into a helix on the phase velocity of the electromagnetic wave circulating on this thick conductor wire. The study was made for various oscillation frequencies. From the experimental data, an attempt is made to develop an initiation of a helicoidal field theory. The experimental study showed the validity of the (v sub f/c (r sub o)) law. Consequently, it is remarkable to affirm that for radii of conductor wire practically possible, the phase velocity of an electromagnetic wave on a helicoidal conductor is quasi-independent of the radius r sub o of the wire. This property can be of great importance in a mechanical realization: the choice of r sub o is without effect on (v sub f/c). Author (NSA)

N70-42069# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.
HODOSCOPE SYSTEMS IN CROSSED FIELDS
N. F. Aleksandrov, N. K. Vishnevskii, O. S. Korolkova, V. G. Lapshin, L. G. Leitezen et al 1969 13 p refs In RUSSIAN
(IFVE-SEF-69-22) Avail: AEC Depository Libraries

A hodoscope system in crossed magnetic and electrical fields with fast plastic scintillators is described. This system in accordance with a number of characteristics can be considered as an intermediate system between wire chambers and conventional scintillation hodoscopes. Also, some possibilities of using this system for filmless readout of the information from the spark chambers are discussed. Author (NSA)

N70-42247# Air Force Cambridge Research Labs., Bedford, Mass.
CHAIN OF ARCS AS A DETERMINING FACTOR IN EXPLOSION OF WIRES
Jan. Nasilowski 23 Jun. 1970 18 p refs Transl. into ENGLISH from Przeglad Elektrotechniczny (Poland), v. 42, no. 10, 1966 p 401–404
(AD-709365; AFCRL-70-0364; AFCRL-TRANS-81) Avail: NTIS CSCL 9/1

The report presents an idea for the uniform description of phenomena associated with electrical explosion of wires and electric fuses, based upon the fact of disintegration of wires into parts with definite spacing. In particular, observations concerned with pre-arcing energy, cutoff currents, peak voltages, and current pause are explained. Author (TAB)

N70-42262*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
ANALYSIS AND SYNTHESIS OF DISTRIBUTED-LUMPED-ACTIVE NETWORKS BY DIGITAL COMPUTER Annual Report, 1 Sep. 1969–31 Aug. 1970
L. P. Huelsman 31 Aug. 1970 11 p
(Grant NGL-03-002-136)
(NASA-CR-114213) Avail: NTIS CSCL 09C

Ways in which a modern digital computing facility may be applied to the analysis and synthesis of DLA networks (networks containing distributed, lumped, and active elements) were investigated. This class of networks is applicable to modern filter circuit design, because the fabrication techniques used to realize integrated circuits readily produce distributed, lumped, and active elements. DLA networks also permit ready realization of networks with resonant characteristics of the type usually characterized as bandpass and band-elimination, without requiring the use of inductors. Author

N70-42289 Northwestern Univ., Evanston, Ill.
OPTIMAL LINEAR CONTROL SYSTEMS WITH INCOMPLETE STATE MEASUREMENTS
John David Ferguson (Ph.D. Thesis) 1969 57 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 70-51

Optimal control laws usually require the feedback of each state variable of the plant. For a linear plant, possibly with time varying parameters, the control which minimizes a performance index which is the integral of a quadratic form of the state plus a quadratic form of the control variable is chosen. The problem is solved as a proportional feedback of each state variable of the plant. If some state variable can not be measured, the solution can not be implemented. In contrast, the basic accumption is that only a measurement, $y = Cx$, is available for feedback. A linear feedback control law, $U^*(y)$, is derived such that the resulting closed loop system is optimal in the sense of minimizing a quadratic performance index. Dissert. Abstr.

N70-42373*# Arizona Univ., Tucson. Computer Science Research Lab.
A SOLID-STATE CROSSBAR SWITCH FOR AUTOMATIC ANALOG-COMPUTER PATCHING
A. Yagi (Electrotech. Lab., Tokyo) Jul. 1970 23 p refs *Its* CSRL Memo. No. 208
(Grant NGR-03-002-024)
(NASA-CR-114225) Avail: NTIS CSCL 09C

An all-electronic crossbar switch consisting of FET series-shunt switches inside the feedback loops of monolithic operational amplifiers was designed and constructed. A time-shared solution of five different differential equations was obtained by using four integrators on ASTRAC 2, with a new solution being generated 250 times per second. Author

N70-42378 Connecticut Univ., Storrs.
THE p-n JUNCTION CAPACITANCE
William Ruthven Smith, III (Ph.D. Thesis) 1969 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-1316

The nature of p-n junction capacitance was studied both theoretically and experimentally. The study, as well as several recent theories, indicates that the voltage intercept of the inverse capacitance squared versus voltage curve for abrupt junctions is dependent on the lightly doped side only; and the indicated concentration, from the slope of the inverse capacitance squared-voltage line, is virtually the weak side majority carrier concentration. Experimental data and some from the literature are compared to various inverse capacitance squared-voltage expressions with good agreement. The deviation of the voltage intercept from the diffusion potential is due to the presence of spillover carriers from the heavily doped side into the lightly doped material, pushing the intrinsic point into the lightly doped side. The intrinsic point is considered the demarcation of the center of the capacitor. Dissert. Abstr.

N70-42443 Polytechnic Inst. of Brooklyn, N.Y.
ERROR BOUNDS FOR THE BINARY INPUT, GAUSSIAN NOISE CHANNEL WITH QUANTIZATION
Edward Arthur Walvick (Ph.D. Thesis) 1969 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-17806

The problem considered in this dissertation is the determination of some bounds on the probability of error for transmission over a discrete time, additive Gaussian noise channel. The input to the channel is a stream of signals, each of which is a random variable, which has amplitude + A or − A. The output is a stream of random variables, each of which has a Gaussian distribution with mean + or − A and unit variance. The output is passed through an L-level quantizer. Also, a noiseless feedback link may or may not be available depending on the system analyzed. Capacity is determined, for a given A, as a function of the number of levels of quantization. Also, for a given number of levels, optimum division of output levels is considered. Bounds on the error exponent for block coding are also found as a function of the number of quantization levels for no feedback (upper and lower bounds), information feedback (lower bound) and decision feedback (upper and lower bounds). Dissert. Abstr.

N70-42485 City Univ. of New York.
TIME-OPTIMAL CONTROL OF LINEAR SYSTEMS WITH CONTROLLER OF PARTIALLY SPECIFIED STRUCTURE
Richard David Klafter (Ph.D. Thesis) 1969 187 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-19061

Time-optimal control of an nth order, linear, time-varying plant with one constrained and (r-1)-unconstrained inputs and m-constrained outputs are discussed. Magnitude, integral, and quadratic constraints are considered. The controller for the constrained input is found in the absence of the output limitations using the functional analysis approach. The controller for the unconstrained inputs consists of a linear feedback arrangement. The values of the feedback coefficients in this specified portion of the controller are adjusted to satisfy the output constraints. Dissert. Abstr.

N70-42720 Washington Univ., Seattle.
ON THE SUBOPTIMAL CONTROL OF NONLINEAR DYNAMICAL SYSTEMS
Gerhard Karl Ludwig Kriechbaum (Ph.D. Thesis) 1969 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-18296

A suboptimal control method for nonlinear autonomous systems was developed which is based upon the approximation of the necessary conditions for optimal control of a nonlinear and a state dependent linear system both being controlled by the same controller. The method results from approximating the nonlinear system by a linear system. The approximation is performed over all state variables. A least squares approximation technique is utilized which generates the desired approximation. It was found that the linear approximant consists of a set of hyperplanes which may or may not pass through the origin. The system of linear equations for determining a particular hyperplane is derived. The values of the feedback gains in the optimal linear controller are modified. Since the method is based upon the optimal control techniques for linear systems, it can be expected to be applicable only to systems which can be linearized. In addition, it is necessary that the optimal control for the linear approximant can be obtained and that the suboptimal control for the nonlinear system exists. Dissert. Abstr.

N70-42833 Missouri Univ., Rolla.
MICROWAVE PROPAGATION THROUGH ISOTROPIC INHOMOGENEOUS PHOTOCONDUCTIVE MEDIA
Thomas Paul Van Doren 1969 194 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-19433

The electromagnetic field equations for microwave propagation through a rectangular waveguide filled with a lossy, isotropic, linear, inhomogeneous material are derived in matrix form and solved numerically by computer. The theoretical effects of photoinduced conductivity and dielectric constant variations on microwave attenuation, phase shift, and voltage standing wave ratio are plotted for typical examples in the X band frequency range. The theoretical calculations indicate that a two order of magnitude change in the conductivity can produce a 25 db change in the attenuation or a 100 degree change in the angle of the reflection coefficient. The theoretical predictions are verified qualitatively by experiments performed on photosensitive cadmium sulfide. Microwave applications for photoconductive materials are described. Microwave measurement of the free electron lifetime in photoexcited cadmium sulfide is also reported. Dissert. Abstr.

N70-42925# Naval Postgraduate School, Monterey, Calif.
DETERMINING PARTITION ELEMENTS WITH FEEDBACK CONSTRAINTS
Thomas Joseph Breckon (M.S. Thesis) Jun. 1970 75 p refs
(AD-709910) Avail: NTIS CSCL 9/2

The partition problem is that step in the layout problem in which it must be decided which of the elementary digital circuits are to be coalesced into a single, electronic package. A solution of the partition problem must satisfy constraints on the maximum number of elementary circuits that can be put into a single package, and on the number of external connections that can be attached to the package. A solution due to Lawler et al, which minimizes delay caused by clustering electronic elements, is extended to cyclic networks. A new algorithm to extract from a graph the maximal strongly-connected subgraphs (lobes) is developed, and a new approach to clustering the digital elements of a lobe is presented. The digital circuit is represented by a bipartite graph, and solutions are expressed in terms of graph theory. Author (TAB)

N70-43028# Army Electronics Command, Fort Monmouth, N.J.
THE TIME DISPERSIVE CHANNEL AS A LINEAR ENCODER Final Report
Theodore J. Klein Jun. 1970 128 p refs
(AD-710237; ECOM-3288) Avail: NTIS CSCL 9/4

The problem considered in the report is that of reducing intersymbol interference caused by time dispersive channels. This is not a new problem, and much recent work has centered on the use of the Tapped Delay Line (TDL) equalizer. The conventional approach is to choose the no dispersion channel as the desired channel, and then to minimize some measure of the intersymbol interference. The approach described in this report recognizes the encoding properties of time dispersive channels. These channels process the transmitted data in much the same way as the generator of a cyclic algebraic code. Two methods of attack are taken. In the first method the code generator coefficients are used as the desired response for an otherwise conventional TDL equalizer. This method is termed the Coded Equalizer method. Transmission of k q-ary code word. Thus, error correction can be obtained with an ordinary algebraic decoder, and without transmission of parity symbols. In the second method the channel encoding is accepted without further processing by a TDL equalizer, to minimize the additive noise variance subject to the constraint that inter-symbol interference be eliminated. A modification of this method allows trading computation time for a limited amount of intersymbol interference. Author (TAB)

N70-43066# Army Electronics Command, Fort Monmouth, N.J.
COMPUTER AIDED ANALYSIS OF CASCADED MICROWAVE TWO-PORT NETWORKS
Thomas Arell and Carl Lump Apr. 1970 51 p refs
(AD-710239; ECOM-3257) Avail: NTIS CSCL 9/5

A generalized computer program has been written to analyze microwave cascaded two-port networks. Circuit configurations employing a shunt feedback loop may also be considered. The program utilizes matrix manipulation of ABCD and Y parameters to obtain the combined network matrix in terms of ABCD parameters. The program is capable of solving problems involving circuits containing any number of cascaded elements as well as networks containing two elements (or two cascaded circuits) in parallel.
Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N70-41958*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FERRY SYSTEM Patent Application
Thomas A. Blackstock, inventor (to NASA) 24 Aug. 1970 9 p
(NASA-Case-LAR-10574-1; US-Patent-Appl-SN-66206) Avail: NTIS CSCL 01E

An auxiliary lift system to provide a means of transportation for large lifting entry vehicles is described. A bolt-on ferry package is provided which includes a body member adapted to be received by and connected to the entry vehicle. A pair of swept wings extend from the body member with at least one propulsion engine being attached to each wing. Fuel tanks for the propulsion engines are formed within the wings and body member. The ferry system is calculated to permit transportation of the HL-10 lifting vehicle over approximately 1000 miles to thereby provide economical transportation for the vehicle from site of manufacture to launch or from landing site to refurbishment location.
NASA

N70-41963*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME RESULTS OF RECENT RESEARCH ON FAN AND JET NOISE AT LEWIS RESEARCH CENTER
Newell D. Sanders [1970] 16 p refs Proposed for presentation at the 7th Ann. Meeting of the ASME, New York, 30 Nov.–3 Dec. 1970
(NASA-TM-X-52871) Avail: NTIS CSCL 20A

A six-foot-diameter low-speed fan designed for low-noise production was tested to provide data on noise generation, suppression effects of acoustic treatment, and exhaust jet noise. Preliminary results showed that the overall noise varied with the 5.5 power of the fan speed but was independent of blade loading obtained by varying back pressure at constant speed. The low-velocity jet from the fan produced noise that followed the eighth power law and was lower than predicted by extrapolation of the SAE curve. Modifying the SAE method to eliminate the effects of jet density greatly improved the agreement between prediction and data.
Author

N70-42014*# Singer-General Precision, Inc., Little Falls, N.J.
QUASI-OPTIMUM DESIGN OF CONTROL SYSTEMS FOR MOVING BASE SIMULATORS
Bernard Friedland and Chong K. Ling Washington NASA Oct. 1970 92 p refs
(Contracts NAS2-2646; NAS2-3636)
(NASA-CR-1613) Avail: NTIS CSCL 14B

The optimal control of a six degree-of-freedom moving-base simulator which utilizes the quasi-optimal control method due to Friedland is discussed. The problem is to determine a control law for moving the simulator cab so that its motion will best approximate the desired aircraft response, and not exceed the limited translational capability of the simulator. By use of the method, a variety of quasi-optimal responses, each emphasizing different features thought to be important in motion perception were obtained. Examples of the results are given, and the considerations important in initial subjective evaluations by experienced flight personnel are discussed. Final evaluation must be made by actual experiments in a motion simulator.
Author

N70-42052*# Scientific Translation Service, Santa Barbara, Calif.
CHARACTERISTICS AND POSSIBILITIES OF THE LARGE SONIC WIND TUNNEL AT MODANE-AVRIEUX [CARACTERISTIQUES ET POSSIBILITES DE LA GRANDE SOUFFLERIE SONIQUE DE MODANE-AVRIEUX]
M. Pierre Washington NASA May 1970 80 p refs Transl. into ENGLISH of French report ONERA-NT-134
(Contract NASw-2035)
(NASA-TT-F-12986; ONERA-NT-134) Avail: NTIS CSCL 14B

The characteristics of the 80,000 kW, 8-meter wind tunnel are presented, as well as the various model installations and the numerous measuring devices, which are permanently developed and multiplied. The tests already carried out are summarily examined; they include conventional aerodynamic measurements, motorized tests with the engines actually running or simulated by air jets, propeller and rotor tests, canopy ejection, habitability without canopy, visibility in the rain and icing and deicing tests.
Author

N70-42238# Air Force Logistics Command, Wright-Patterson AFB, Ohio. Packaging Evaluation Agency.
PACKAGING ENGINEERING FOR AIR FORCE SYSTEMS Annual Report, 1969–1970
Jun. 1970 59 p refs
(AD-709207) Avail: NTIS CSCL 13/4

The mission of the agency includes programs to provide to the Department of the Air Force a single packaging engineering capability and test facility that will be available to all major air commands, to investigate, develop, test, and evaluate packaging materials, containers, methods, systems and techniques for adequacy and cost effectiveness, to provide a single Air Force location for storage and reference to packaging design and test data, and to program and direct work on a priority basis to provide best utilization of the Air Force Packaging Agencys facilities and personnel.
Author (TAB)

N70-42360# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (West Germany). Inst. fuer Chemische Raketenantriebe.
THE INFLUENCE OF SPRAY COOLERS ON THE RANGE OF OPERATION OF HIGH-ALTITUDE PROPULSION TEST FACILITIES [DER EINFLUSS VON EINSPRITZKUEHLERN AUF DEN BETRIEBSBEREICH VON RAKETENHOEHENPRUEFSTAENDEN]
Joachim Nitsch Jun. 1970 53 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-24) Avail: NTIS; ZLDI Munich: 14,40 DM

Exhaust gas cooling in high altitude propulsion test facilities can be done by spray coolers. Special conditions arising from the low pressure and from the high vapor portion of the gas-vapor mixture are explained and calculations for a cross flow spray cooler are described. Experiments can be performed at 19 different operation points of the facility. The measurement devices and the experimental procedures are explained and an empirical correction factor which was applied to the calculated cooler performance graph is given. The Lampoldshausen high altitude test facilities can be used for propulsion engines up to 55 kN thrust and up to 70 kN thrust with small modifications.
Author (ESRO)

N70-42428*# Hamilton Standard, Farmington, Conn.
LINEAR AND ANGULAR VIBRATION MEASUREMENT OF V/STOL AIRCRAFT, VOLUME 1 Final Technical Report
D. Isakson Apr. 1970 142 p
(Contract NAS12-2028)
(NASA-CR-110822) Avail: NTIS CSCL 14B

A system for measuring linear and angular vibration environments in V/STOL aircraft was developed. A measured environment was then processed through an error model of a strapdown inertial guidance system and the resulting system errors tabulated. Three main objectives were attained: (1) Design and fabrication of the sensor package and associated electronics. (2) Measurement of the vibration characteristics of a helicopter. (3) Prediction of the performance of a strapdown inertial system operating in such an environment. The vibration monitor was used to measure vibrations on several flights. The flight tapes were reduced to oscillograph plots. Flight idle and forward flight conditions were selected for generation of power spectral density plots. A description of the hardware and program summary is presented. Volume 2 contains test descriptions, test results, and raw field data.
Author

N70-42429*# Hamilton Standard, Farmington, Conn.
LINEAR AND ANGULAR VIBRATION MEASUREMENT OF V/STOL AIRCRAFT, VOLUME 2 Final Technical Report
D. Isakson Apr. 1970 300 p
(Contract NAS12-2028)
(NASA-CR-110821) Avail: NTIS CSCL 14B
For abstract, see N70-42428.

N70-42475# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
INSTALLATION FOR THE STUDY OF MULTIPLE FLOW JET EXHAUST NOZZLES [INSTALLATION POUR L'ETUDE DE TUYERES DE REACTEURS A PLUSIEURS FLUX]
Guy Fasso, Maurice Pletin, and Pierre Broussaud 1970 27 p refs In FRENCH; ENGLISH summary
(ONERA-NT-160) Avail: NTIS

The equipment for the study of jet engine nozzles and after-bodies without external flow or in a blowdown wind tunnel, at transonic speeds or at Mach 2, is described. The Reynolds number obtained is 1/3 of that encountered in flight. The primary flow, which is constant, may reach 18 to 20 kg/sec and the secondary and tertiary flows, which can be varied by steps, are 16% to 30% of the primary flow; the useful duration of a run varies from 1 to 3 minutes. The thrust balance, of 10 kN capacity, is associated with a flow distribution unit (dynalpy balance) and can be installed outside the wind tunnel. The force and pressure measurement pick-ups, the transcription and data handling devices, and also the calibration results, are described in detail. The global absolute accuracy is of the order of + or × 840.2%. More than 1000 runs have been carried out at rest on a 1/10th scale model of the Concorde engine after-bodies. Author (ESRO)

N70-42554# Stanford Linear Accelerator Center, Center.
THE SLAC LH2 TARGET CONTROL SYSTEM
W. B. Pierce Jun. 1970 32 p refs Presented at 3d Intern. Conf. on Magnet Technol., Hamburg, May 1970 Supported by AEC
(SLAC-PUB-753; CONF-700503-4) Avail: NTIS

The control system for the liquid lithium hydride target at the Stanford Linear Accelerator is described. The silicon diode probe for indicating the lithium hydride level, the semiautomatic vacuum system, the air flow monitor, the H2 detectors, and the pressure transducers are described. NSA

N70-42671# Princeton-Pennsylvania Accelerator, Princeton, N.J.
MACHINERY ROOM DATA ACQUISITION SYSTEM
Stanley Hochman 22 Apr. 1970 5 p Presented at Digital Corporation Users Soc. Spring Symp., Atlantic City Submitted for publication
(Contract AT(30-1)-2137)
(PPAD-674-E; CONF-700524-1) Avail: NTIS

The data acquisition system described is designed to record via printed teletype output, 100 points of temperature, pressure, voltage, liquid flow, current, and power information from a machinery room that supports a physics nuclear accelerator.
Author (NSA)

N70-42827 National Lending Library for Science and Technology, Boston Spa (England).
RESIDENTIAL AREAS IN THE VICINITY OF AN AIRPORT [BOLIGSTROEK NAER FLYPLASSER]
G. Oe. Joergen Nov. 1969 11 p refs Transl. into ENGLISH of Norges Buggforskningsinst. Reprint No. 161
(NLL-Lib-Comm-1527-(5196)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Noise intensity levels in houses and buildings near airports are considered. The problem is considered with respect to the number of houses and buildings that must gradually be condemned due to increasing noise intensity and requirements for insulation to make existing buildings acceptable. Noise zones around airports are also established to determine what types of building are prohibited in the individual zones. The development of criteria for acceptable noise intensity in different situations is also discussed.
R.B.

N70-42908# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DESCRIPTION OF THE COMPUTER PROGRAM FOR THE SAFEGUARDS MATERIAL BALANCE SIMULATOR
J. W. Johnston and R. L. Engel May 1970 165 p
(Contract AT(45-1)-1830)
(BNWL-1357) Avail: NTIS

A computer program designed to simulate the flow and measurement of nuclear material in the material balance accounting phase of safeguards is described. The structure and uses of the Safeguards Material Balance Simulator (SMBS) are described. Detailed descriptions are also included on input data requirements, calculational formulas and output formats, the computer hardware and software presently used by Battelle-Northwest, and the computer logic used for handling mixed data types. Data for test cases are also included to exemplify how the SMBS is used. The examples from the test cases are explained in detail.
Author (NSA)

N70-42922# Brookhaven National Lab., Upton, N.Y.
THE SLOW EXTERNAL BEAM AT THE BROOKHAVEN AGS
Mar. Q. Barton 24 Sep. 1969 10 p refs
(BNL-50225) Avail: NTIS

The development and operation of the slow external beam extraction system at the Brookhaven AGS is described. The system is composed of resonance perturbation sextupole magnets, the septum magnet, and the ejector magnet. It is expected that the extraction efficiency of the system can be tuned to 80 or 85%.
NSA

N70-42984*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
APPLICABILITY OF AIR FORCE FLIGHT DYNAMICS LABORATORY HIGH TEMPERATURE STRUCTURAL FACILITY TO SPACE SHUTTLE COMPONENT TESTS
Robert L. Cavanaugh and Sanford Lustig *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 101-122 (See N70-42976 24-30)
Avail: NTIS CSCL 14B

The major hypersonic structure test programs conducted at the Structures Test Facility are summarized and the test facility,

with its load and temperature environment simulation capabilities, is described. The 50-MW Gas Dynamics Facility, which can be used to investigate the effects of high temperature and mass flow, is also described. It is concluded that the two existing facilities can be used in the structural development testing of lifting body, orbital entry vehicles. N.E.N.

N70-42994*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TEST FACILITIES FOR SPACE SHUTTLE THERMAL PROTECTION SYSTEM
R. R. Howell *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 229–238 (See N70-42976 24-30)
Avail: NTIS CSCL 14B

Some of the problems associated with experimental evaluation of thermal protection systems and with the associated testing capability requirement are reviewed. The problem of experimentally establishing the relative merits of thermal protection concepts proposed for the space shuttle is made complex by the different simulation requirements for the different possible failure modes. Test facilities capable of simultaneous simulation of different parameters in combination as required for TPS screening do not currently exist. Overall evaluation of thermal protection systems apparently requires testing of large specimens under correct combinations of aerodynamic heating and loading. Facilities currently available for such evaluation and verification tests are believed to be inadequate. Author

N70-43045# RAND Corp., Santa Monica, Calif.
THEORETICAL DESCRIPTION OF THE PERFORMANCE OF THE UTIAS HYPERVELOCITY LAUNCHER
H. L. Brode Jul. 1970 48 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-710588; RM-6298-PR) Avail: NTIS CSCL 14/2

A detailed analysis is presented of the theoretical firing of an implosion-driven hypervelocity launcher. Using hydrodynamic equations, a mathematical model is developed of the entire launcher cycle from the initiation of detonation in the hydrogen-oxygen gas through the detonation of the high-explosive PETN, the breaking of the diaphragm and acceleration of the projectile, the losses to the barrel walls from turbulent heat transfer, drag, and ablation, and the shocking of the air or gas ahead of the projectile. The loss calculations had not previously been applied to the launcher design. Wall and projectile losses appear to deserve serious treatment. Calculated velocities for the case studied range from 8 to 12 km/sec while similar experiments run to only 6 or 7 km/sec. Initial accelerations are too high to allow projectile survival; and some improvements are suggested. Author (TAB)

N70-43059# Cambridge Electron Accelerator, Mass.
[ELECTRON ACCELERATOR: OPERATION AND EXPERIMENTS, AND COLLIDING BEAM FACILITY DEVELOPMENT] Semiannual Report, 1 Jul.–31 Dec. 1969
K. Strauch and W. A. Shurcliff 10 Apr. 1970 51 p
(Contract AT(30-1)-2076)
(CEAL-1051) Avail: NTIS

The 19 experiments underway or in preparation are reported. Progress is summarized on the colliding beam facility in which electron and positron beams, each with an energy as high as 3.5 GeV will collide with an available energy of 7.0 GeV in the center-of-mass system. The performance of the 130-MeV electron linac was improved and the Varian 130-MeV positron linac was installed and tried out successfully. The vacuum system of the accelerator ring was improved, and with a 2.6-GeV constant-energy electron beam stored in the synchrotron, a 1/e lifetime of two hours was achieved. The bypass hardware also was improved, and with a 2-GeV electron beam stored in ring and bypass, a 1/e lifetime of 45 minutes was obtained. The 120-ft-long, low-beta bypass train in which the collisions are to occur was tuned and adjusted. Many studies were made of apertures, betatron frequencies, and other parameters. Construction of the on-line detector for analyzing results of the e(−)e(+) collisions is nearing completion and many tests on component and component subassemblies were completed successfully. Progress was made on an optical detector and a magnetic detector. Author (NSA)

N70-43149*# Consultants and Designers, Inc., Arlington, Va.
CLEAN ASSEMBLY AND STERILIZATION LABORATORY Final Report
Dec. 1969 100 p refs
(NASA Order S-50196A)
(NASA-CR-110897) Avail: NTIS CSCL 14B

The operation of the GSFC Clean Assembly and Sterilization Laboratory for development of sterilization and clean room procedures is described. The operational and research functions are emphasized and breadboard and flight experiment hardware were processed as test models of sterile assembly procedures. Several procedures were developed for improving the sensitivity and efficiency of routine techniques in recovery of low numbers of microorganisms. The R & D capability of the laboratory in developing planetary quarantine procedures is demonstrated. Author

N70-43159# Stanford Linear Accelerator Center, Calif.
TWO-MILE ACCELERATOR PROJECT Quarterly Status Report, 1 Jan.–31 Mar. 1970
Jun. 1970 69 p refs
(Contracts AT(04-3)-400; AT(04-3)-515)
(SLAC-120; QSR-31; QSR-25) Avail: NTIS

A status report on the Stanford Linear Accelerator Project covering the period January 1, 1970 to March 31, 1970 is presented. Topics included are accelerator and research area operations, accelerator and research area equipment development, and physics research equipment development. Author (NSA)

N70-43200# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CRITERIA FOR INSPECTION, EVALUATION, CLASSIFICATION, AND REUSE OF USED AIRFIELD LANDING MAT Final Report
Philip J. Vedros and Donald N. Brown May 1970 80 p ref
(AD-708891; S-70-2) Avail: NTIS CSCL 1/5

The instruction report presents a method for the systematic separation and classification of used panels of M8Al, AM2, XM18, and XM19 landing mats as reusable or unsuitable for future use as light- or medium-duty landing mat. For cases in which the used mat is not suitable for airfield surfacing, suggested secondary uses are presented. Author (TAB)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N70-41827 City Univ. of New York.
THE STABILITY OF A FILAMENT OF A VISCOELASTIC FLUID
Joseph Yerushalmi (Ph.D. Thesis) 1969 221 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-19051

The stability of a filament of fluid which is initially at rest (relative to small surface disturbances) is studied in reference to the phenomenon of the break-up of capillary jets. The stability analysis shows that a jet of a viscoelastic fluid which is characterized by a complex viscosity that is bounded in absolute value is less stable than a jet of a Newtonian fluid of the same zero viscosity. The steady state behavior of a liquid filament under tension is

studied within the context of fiber spinning processes. The results of the theoretical analysis show that fluids which exhibit an apparent viscosity which increases with the axial component of the deformation-rate, are capable of forming filament (under tension) of lengths greater than the corresponding filaments of fluids which do not possess this property. The, physically observed, superior spinnability of viscoelastic fluids over Newtonian fluids is, hence, attributed to the above property. Dissert. Abstr.

N70-41838 Rice Univ., Houston, Tex.
AN EXPERIMENTAL EVALUATION OF THE TOTAL AND ABLATION PRODUCTS RADIATION IN A HYPERSONIC SHOCK LAYER
Martin Harold Hirsch (Ph.D. Thesis) 1969 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-19298

An experimental technique was developed to measure the absolute intensity of radiation as a function of position in a radiating shock layer. A radiative heat flux equation was derived for a volume of gas in the shock layer radiating to the surface of the model at the stagnation region. It was found that the radiation from the ablation products in the shock layer is an order of magnitude greater than that from the shock layer air. The total radiation heat flux for a four inch diameter Teflon model was 806 watt/sq cm and that for a water cooled copper model of the same configuration was 36 watt/sq cm. For a given ablative material, as the size of the model increases, the total radiative heat flux decreases; this is attributed to the fact that the mass injection rate per unit area decreases. Dissert. Abstr.

N70-41906 Princeton Univ., N.J.
COLLISIONS BETWEEN INTERSTELLAR H I CLOUDS
Michael Eric Stone (Ph.D. Thesis) 1969 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-18191

Numerical, hydrodynamical models were developed for head-on collisions between two identical interstellar clouds. Non-adiabatic cooling by atomic line radiation and heating by cosmic rays are both included explicitly. The one-dimensional model consists of the collision between two slabs of gas infinite in extent transverse to the collision direction. The two-dimensional model involves two initially spherical clouds of 350 solar masses each. One-dimensional models were constructed for several sets of assumptions about the internal thermodynamics, initial homogeneity, presence of gravity, and presence of an internal magnetic field. All the models display the same general behavior. The two-dimensional model confirms and extends the conclusions of the one-dimensional model. In the collision direction the motion is nearly identical to that of the one-dimensional model. Dissert. Abstr.

N70-41919*# Translation Consultants, Ltd., Arlington, Va.
THE ACTION OF UNSTEADY PRESSURE PULSE ON A BODY IN A LIQUID OR GAS [OB IMPULSE NESTATSIONARNOGO DAVLENIYA, DEYSTVUYUSHCHEGO NA TELA V ZHIDKOSTI ILI GAZE]
A. I. Golubinskiy et al Washington NASA Oct. 1970 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 1, Jan.–Feb. 1970 p 113–120
(Contract NASw-2038)
(NASA-TT-F-13263) Avail: NTIS CSCL 20D

It is demonstrated that, within the limits of linear theory, a detailed computation of the nonstationary flow picture can be avoided by reducing the determination of the pulses to a problem with fewer measurements. Author

N70-41920*# Translation Consultants, Ltd., Arlington, Va.
THE TURBULENT FLOW OF A CONDUCTING FLUID IN A LONGITUDINAL MAGNETIC FIELD [O TURBULENTNOM TECHENII PROVODYASHCHEY ZHIDKOSTI V PRODOLNOM MAGNITNOM POLE]
D. S. Kovner et al Washington NASA Oct. 1970 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 1, Jan.–Feb. 1970 p 10–17
(Contract NASw-2038)
(NASA-TT-F-13261) Avail: NTIS CSCL 20D

A hypothesis is formulated with respect to a term describing the Joule dissipation of turbulent energy. The change in the structure of the turbulence of a flow in a magnetic field is taken into consideration. Author

N70-41976*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ACCUMULATOR Patent Application
Luther B. Powers, James A. Long, and Emmett B. Jones, inventors (to NASA) Filed 17 Aug. 1970 10 p
(NASA-Case-MFS-10354; US-Patent-Appl-SN-64392) Avail: NTIS CSCL 20D

The invention is a device for suppressing pressure oscillations in a fluid transmission line. The device includes a coupling cap connected directly into the fluid line and the cap has a cross-sectional area considerably larger than that of the fluid line. A bellows and housing are mounted on the coupling cap so as to define two separate volumes, an external and internal volume. The internal volume is formed by the coupling cap and the interior of the bellows and this volume is directly connected to the fluid line. The external volume, the space between the exterior of the bellows and the housing, is either pressurized and sealed off or connected to a source of pressure so that a selected pressure load can be applied to the exterior surface of the bellows. The bellows will stroke, i.e. expand and contract, in response to pressure fluctuations in the fluid line in a compensating manner which suppresses (damps out) these oscillations. NASA

N70-41977*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID AEROSOL DISPENSER Patent Application
Robert J. Naumann and David Jex, inventors (to NASA) Filed 7 Aug. 1970 10 p
(NASA-Case-MFS-20829; US-Patent-Appl-SN-61894) Avail: NTIS CSCL 20D

A liquid aerosol dispenser is disclosed having an explosively driven piston that compresses a light gas to an extremely high pressure so as to rupture a first sealer on a container holding the liquid to allow admixing of the gas and the liquid. The container has a plurality of discharge nozzles covered with a rupturable sealer and upon rupture of the first sealer and admixing of the light gas and liquid, the sealer covering the nozzles is ruptured so as to allow the liquid to be expelled through the nozzles at a very high velocity in extremely fine droplet form. NASA

N70-41998*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VELOCITY, INTERMITTENCY, AND TURBULENCE INTENSITY MEASUREMENTS IN THE BOUNDARY LAYER OF AN ACCELERATED FLOW
Donald R. Boldman, Harvey E. Neumann, and Robert C. Ehlers Washington Oct. 1970 35 p refs
(NASA-TN-D-6043; E-5689) Avail: NTIS CSCL 20D

Boundary layer surveys of time-mean velocity, intermittency, and turbulence intensity were obtained in a 30 deg half-angle of convergence nozzle operating with air. The measurements were obtained by means of a constant temperature hot-wire anemometer. The tests, which were performed at adiabatic wall conditions, revealed some of the effects of strong acceleration on an initially turbulent boundary layer. Author

N70-42046*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF PRESSURANT INLET CONFIGURATION ON LIQUID OUTFLOW IN WEIGHTLESSNESS
Steven G. Berenyi Washington Oct. 1970 13 p refs
(NASA-TM-X-2108; E-5716) Avail: NTIS CSCL 20D

An experimental study was conducted to investigate the effect of various pressurant inlet configurations on the draining process during liquid outflow from a cylinder in weightlessness. Both normal gravity measurements and actual outflow tests in a weightless environment are reported. The normal gravity tests were made to set up various internal tank pressure distributions, and the weightless tests were conducted to measure the liquid residuals remaining in the tank at the time of vapor ingestion. The internal tank pressure distributions examined were peaked in the center of the tank, peaked at the tank wall, and nearly uniform throughout the tank. The nearly uniform distribution produced the least distortion of the interface in weightlessness and, therefore, the lowest liquid residuals. Author

N70-42060# Akademiya Nauk SSSR, Novosibirsk.
EXPERIMENTS WITH STRONG SHOCKWAVES ON VODA 1
V. A. Kapitonov et al Sep. 1969 11 p refs Preprint
(NP-TR-1861) Avail: NTIS

Experiments are described on the excitation of strong collisionless shock waves (M approximately greater than 5) with subsequent containment of the plasma by the magnetic field of the shock loop. A magnetic piston of approximately 20 kOe was produced within approximately 100×10 to the minus 9th power sec by a current generator forming a long line with water insulation for 250 keV and wave impedance of 1 ohm. Author (NSA)

N70-42119*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRESSURE WAVE PROPAGATION THROUGH ANNULAR AND MIST FLOWS
Robert E. Henry [1970] 30 p refs Presented at 63d Ann. Meeting of Am. Inst. of Chem. Engr., Chicago, 29 Nov.–3 Dec. 1970
(NASA-TM-X-52882) Avail: NTIS CSCL 20D

One dimensional models are formulated to describe pressure wave propagation through one- and two-component annular and mist flow patterns. The solutions include the effect of inertial interphase momentum in these configurations. In addition, the nature and importance of interphase mass transfer is discussed for one-component systems. The models exhibit good agreement with the available data. Author

N70-42137*# Translation Consultants, Ltd., Arlington, Va.
NUMERICAL SOLUTION OF CERTAIN GAS DYNAMIC PROBLEMS [CHISLENNOYE RESHENIYE NEKOTORYKH ZADACH GAZOVOY DANAMIKI]
O. M. Belotserkovskiy et al Washington NASA Oct. 1970 22 p refs Transl. into ENGLISH from Zh. Vychislitelnoi Mat. i Mat. Fiz. (Moscow), v. 10, no. 2, 1970 p 401–416
(Contract NASw-2038)
(NASA-TT-F-13229) Avail: NTIS CSCL 20D

Research results on gas dynamics problems on high-speed electronic computers are discussed, and basic ideas involved in the construction of the corresponding schemes are given. Author

N70-42154*# City Univ. of New York. Dept. of Chemical Engineering.
ATOMIZATION OF VISCOELASTIC FLUIDS Final Report, 1 Jan. 1968–30 Jun. 1969
Reuel Shinnar and Robert Pfeffer May 1970 3 p refs
(Grant NGR-33-013-009)
(NASA-CR-114155) Avail: NTIS CSCL 20D

A linearized stability analysis based on the assumptions that the fluid is completely relaxed predicts that viscoelastic fluids are more unstable than Newtonian fluids with the same zero viscosity. Experiments with highly elastic fluids show that their breakup is governed by nonlinear phenomena and that wave formation is suppressed. Mildly concentrated solutions of highly elastic solutions could not be atomized in a jet, but completely gellified solutions of nonelastic thickeners were atomized very easily. It is important that the relaxation time of the structural recovery of the gel be longer than the breakup time of the jet. Thickeners are obtainable which on the one hand will allow the complete gellification of the fuel, but will also be easily extended through a nozzle and atomized. Such gellified fuels might be important to prevent sloshing and to allow the incorporation of solid particulate additives to liquid fuels. Author

N70-42160*# Advanced Technology Labs., Inc., Jericho, N.Y.
AN ANALYSIS OF INTERNAL SUPERSONIC FLOWS WITH DIFFUSION, DISSIPATION AND HYDROGEN-AIR COMBUSTION
S. Dash May 1970 58 p refs
(Contract NAS1-9560)
(NASA-CR-111783; ATL-TR-152) Avail: NTIS CSCL 20D

Using a modified characteristic calculation accounting for diffusion normal to the streamlines and finite rate chemistry along them, with pressure variations both along and normal to the streamlines, a system of equations is presented which is of a hyperbolic-parabolic nature. A numerical program is generated which calculates nonuniform supersonic flows with diffusive and dissipative effects within two dimensional or axisymmetric nozzles. This analysis is applicable to all viscous, reacting flow fields bounded or unbounded, if the flow remains supersonic and shock free in the domain considered. Stability and accuracy criteria governing the step sizes employed in the numerical scheme are discussed. The overall numerical analysis is then presented, including the difference form of the equations, overall numerical procedure, and a method for uncoupling diffusion and chemistry. Some sample calculations are described, such as the comparison of a nonuniform inviscid flow with its viscous counterpart, and the specific effects generated by combustion on the overall pressure distribution and wave pattern. P.A.B.

N70-42167*# Southwest Research Inst., San Antonio, Tex.
MAGNETIC FLUID SIMULATION OF LIQUID SLOSHING IN LOW GRAVITY
Franklin T. Dodge and Luis R. Garza Aug. 1970 36 p refs
(Contract NAS8-20290; SwRI Proj. 02-1846)
(NASA-CR-102862; TR-9) Avail: NTIS CSCL 20D

An exploratory series of tests of simulated low gravity liquid sloshing was conducted using a magnetic colloid liquid in conjunction with a solenoidal magnetic field. A description of the experimental apparatus and test procedure is presented. The magnetic body force exerted on the liquid was varied by changing the magnetic field strength in order to obtain effective gravity levels as small as 0.01 g. The measured slosh natural frequencies for both cylindrical and spherical tanks in these low gravity conditions agreed very well with theoretical predictions. Slosh damping, however, was significantly larger than expected because of the increase in viscosity of magnetic liquids due to magnetic field effects. A magnetic fluid analysis of sloshing is presented, which indicates that some deviation from true low gravity behavior might occur whenever the Bond number is smaller than one. The discrepancy is caused by a magnetic interaction at the free surface that induces a jump in liquid pressure similar to that induced by surface tension. Author

N70-42195*# General Applied Science Labs., Inc., Westbury, N.Y.
AN INVESTIGATION OF THE HIGH SPEED TURBULENT BOUNDARY LAYER WITH HEAT TRANSFER AND ARBITRARY PRESSURE GRADIENT. PART 2: THE COMPRESSIBILITY TRANSFORMATION: GENERAL CONSIDERATIONS
Constantino Economos Washington NASA Oct. 1970 40 p refs

(Contract NAS1-8424)
(NASA-CR-1680; GASL-TR-719-Pt-2) Avail: NTIS CSCL 20D

Properties of the Coles' compressibility transformation when modified and extended to include turbulent boundary layer flows with mass transfer and pressure gradient are examined. First the formulation for the mass transfer case in the absence of pressure gradient is developed and its applicability demonstrated by comparison with experimental data involving homogeneous and heterogeneous injection as well as chemical reaction. This modified form of the transformation is then applied to the impermeable case and is shown to differ significantly from the earlier Baronti–Libby formulation. In particular, improved agreement with experimental skin friction data obtained under cold wall conditions is demonstrated. The implications of this result with regard to the more general case involving simultaneous mass transfer and pressure gradient are discussed. The inability of the transformation to preserve the wake component of the velocity distribution is also examined. An empirical method is proposed which provides good correlation of the transformed velocity profiles throughout the viscous layer and more realistic prediction for the streamwise variation of skin friction. The applicability of this technique to three-dimensional boundary layers is examined. In particular, the appropriate form of the transformation for flow over a swept cylinder is developed. Author

N70-42196*# General Applied Science Labs., Inc., Westbury, N.Y.
AN INVESTIGATION OF THE HIGH SPEED TURBULENT BOUNDARY LAYER WITH HEAT TRANSFER AND ARBITRARY PRESSURE GRADIENT. PART 3: COMPUTER PROGRAM MANUAL
Jesse Schneider and John Boccio Washington NASA Oct. 1970 93 p refs
(Contract NAS1-8424)
(NASA-CR-1681; GASL-TR-719-Pt-3) Avail: NTIS CSCL 20D

A computer program capable of determining the properties of a compressible turbulent boundary layer with pressure gradient and heat transfer without imposing a Crocco integral to solve the energy equation is described. The program treats either the two-dimensional or axisymmetric problem with either a perfect gas or real gas equilibrium chemistry model for the thermodynamics. Coles' transformation is applied to the equations for the conservation of mass and momentum. In the transformed plane, these are linked with Baronti's incompressible solution and a solution is achieved by numerically solving the resulting system of six ordinary differential equations and one partial differential operation: The partial differential energy equation is written in von Mises coordinates and is essentially solved in the real plane using an implicit first order finite-difference technique. Author

N70-42203# Naval Ship Engineering Center, Washington, D.C. Ocean Engineering Section.
INVESTIGATION OF A METHOD TO PROVIDE MOTION SYNCHRONIZATION DURING SUBMERSIBLE RETRIEVAL
Jon R. Buck and Henry W. Stoll, Jr. 1969 58 p refs Presented at 6th Ann. Tech. Symp., 1969
(AD-709384) Avail: NTIS CSCL 13/10

The paper investigates a dynamically controlled platform used to capture and retrieve submersibles in sea-states up to 4. Author (TAB)

N70-42223# Kansas Univ., Lawrence. Dept. of Chemistry.
STUDIES OF VAPORIZATION KINETICS OF POTASSIUM CHLORIDE AND RAREFIED GAS FLOW WITH A SPHERICAL EFFUSION CELL
Paul C. Nordine (Ph.D. Thesis) 2 May 1970 303 p refs
(Contract AT(11-1)-1140)
(COO-1140-185) Avail: NTIS

The dependence of the vaporization rate of potassium chloride single crystals on the degree of saturation of the gas phase was investigated. The flux of molecules from the first orifice of the effusion cell was monitored with a quadrupole mass spectrometer. The area of the second or auxiliary orifice was changed by means of a mechanism that was operated from outside of the vacuum system. The source for the gas flow studies was a small Knudsen effusion cell that supplied through its own orifice into the spherical effusion cell, a flux of molecules that was independent of the return flux from the sphere. This source contained antimony or KCl powder. The source for the evaporation kinetics experiments was a single crystal of KCl that vaporized directly into the sphere. The two kinds of measurements were of steady state intensity versus orifice area and the intensity versus time after changes in the auxiliary orifice area. Author

N70-42233*# Case Western Reserve Univ., Cleveland, Ohio. School of Engineering.
FLOW EXCURSIONS IN A SIMULATED GAS-COOLED REACTOR PASSAGE
Paul Vingerhoet and Eli Reshotko Sep. 1968 64 p refs
(Grant NGR-36-003-064)
(NASA-CR-110777; FTAS/TR-68-34) Avail: NTIS CSCL 20D

The characteristics of flow excursions believed to result from laminar instability are discussed. The steady state characteristics of helium gas flowing in an electrically heated .094 in. i.d. Nichrome 5 54 in. tube were observed and recorded. Constant pressure drop excursions were also triggered and observed; their time histories are presented. The results tend to substantiate Reshotko's theory that an excursion of nonoscillatory and nonviolet, and has a characteristic time proportional to the heat capacity of the tube, namely of the order of seconds to minutes. Author

N70-42241# Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
MOTIONS RESPONSE OF A RELATED SERIES OF VERTICAL FLOAT-SUPPORTED PLATFORMS IN IRREGULAR SEAS Final Report
John A. Mercier Nov. 1969 116 p refs
(Contract NOw-66-0447-D)
(AD-707049; SIT-DL-69-1334) Avail: NTIS CSCL 13/10

A related series of float supported platforms have been model tested to evaluate their motions response in irregular waves. Model configurations were chosen similar to design studies carried out for water-based aircraft. Effects of variations in major design parameters, such as float slenderness, damping plate size, and metacentric height, for head and beam seas, with three- and four-float configurations, have been studied. Response information is presented in two ways, as transfer functions and as impulse response functions, so that either spectral or time history interpretations may be made. Non-dimensional results are applicable to craft having different displacements. Applications of this type of flotation system include air-sea craft, drill rigs, special buoys, and many others. Author (TAB)

N70-42242# Hydronautics, Inc., Laurel, Md.
EXPERIMENTAL DETERMINATION OF THE STATIC AND DYNAMIC COEFFICIENTS OF SURFACE-PIERCING STRUTS
W. H. Rowe, Jr. and J. O. Scherer Feb. 1970 90 p refs
(Contract N00014-68-C-0202)
(AD-709613; TR-809-1) Avail: NTIS CSCL 13/10

The results of an experimental study of the static and dynamic hydrodynamic coefficients of two surface piercing struts are presented. The struts, one unswept and one with 20 degrees of sweep, were symmetrical with 12 percent thick, modified circular arc sections. Static tests were conducted on both struts with strut immersion depths corresponding to nominal wetted aspect ratios of 1, 2, and 3 over a yaw angle range of +10 to -10 deg for a water velocity of 25 feet per second. Both struts were tested at atmospheric pressure and with reduced ambient pressure in the channel to provide cavitation numbers of 3.3, 1.0, and 0.3. Pure sway motion dynamic tests were conducted on the unswept strut at zero yaw angle for the same range of aspect ratios and cavitation numbers as the static tests. The effects of pure swaying motion were evaluated for an amplitude ratio of 1/8 over the range of reduced frequencies from .03 to .32. Author (TAB)

N70-42307*# General Electric Co., Schenectady, N.Y. Research and Development Center.
MEAN AND FLUCTUATING VELOCITY CONTOURS AND ACOUSTIC CHARACTERISTICS OF SUBSONIC AND SUPERSONIC JETS
H. T. Nagamatsu, R. E. Sheer, Jr., and E. C. Bigelow 15 Sep. 1970 79 p refs
(Contract NASw-1784)
(NASA-CR-114224) Avail: NTIS CSCL 20D

Spark shadowgraph photographs of the jet flow at Mach numbers of 0.6 to 1.4 were obtained which indicated the presence of shock bottles for supersonic Mach numbers. Mean and fluctuating velocities contours were determined for a convergent nozzle from the surveys with impact pressure and piezoelectric pressure gage probes. The velocity and piezoelectric pressure fluctuation contours were similar to subsonic Mach numbers of 0.6 to 1.0. But for supersonic Mach numbers of 1.2 and 1.4 the length of the supersonic region increased as the square of the Mach number and the peak pressure fluctuations occurred close to the sonic velocity contour. For subsonic Mach numbers of 0.6 to 1.0 the peak pressure fluctuations occurred in a toroidal region located approximately 4 to 6 diameters from the nozzle. An analysis was made to show that the output of the piezoelectric pressure gage was proportional to the turbulent velocity fluctuations. Author

N70-42340# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
ON THE HYDROMAGNETIC STABILITY OF A NONUNIFORMLY ROTATING FLUID
A. Brahme 8 Jun. 1970 18 p refs
(Repr-70-12) Avail: NTIS

The stability of nonuniformly rotating mercury in an axial magnetic field was studied. The cylindrically symmetric flow of mercury was driven by a volume force originating from the magnetic field and radial currents in the fluid. Concentric electrodes at the mercury container base were used to vary the current distribution and so to produce different types of velocity profiles in the fluid. The electric field induced in the rotating mercury was used to measure the fluid velocity. The results can be explained by a modified Chandrasekhar criterion for dissipative Couette flow. Author (ESRO)

N70-42380 Northwestern Univ., Evanston, Ill.
SOME CONTRIBUTIONS TO SYMMETRIC OSEEN FLOW IN TWO DIMENSIONS
Arthur K. Gautesen (Ph.D. Thesis) 1969 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-59

Two dimensional viscous flow past symmetric obstacles is investigated within the framework of the Oseen equations. For symmetric flows, it is shown that the Oseen equations can be reduced to an integral equation which involves only one unknown function. From this function, all the flow quantities can be derived. A theorem concerning the positivity of solutions to a certain class of integral equations is derived. As an application of the theorem, the positivity of the local drag for Oseen flow past a flat plate oriented parallel to the oncoming stream is established. This theorem is extended to include a series of coplanar flat plates. The problem of symmetric Oseen flow past a circular shell is investigated asymptotically for small Reynolds numbers. An approximate formula for the drag coefficient is derived, and a calculation of the streamlines is made for representative cases. For the special case of a cylinder, an improved value of the drag coefficient is obtained from variational principles. Dissert. Abstr.

N70-42381 Pennsylvania State Univ., University Park.
BUBBLE REACTION CHARACTERISTICS
James Nicholas Mattav (Ph.D. Thesis) 1969 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-697

Reaction characteristics associated with a gas bubble which is chemically reacting with a liquid through which it is moving were both analytically and experimentally investigated. Particular attention was directed toward bubbles where size changes were significant with distance traveled. A quasi-steady, spherical bubble model was formulated based on the assumption that the effects of bubble motion, mass transfer, heat transfer, and reaction kinetics could be uncoupled and treated independently. Conservation of mass for an isothermal reaction process was used to relate the rate at which the bubble size decreases to reaction kinetics and diffusion in the continuous liquid phase. Introduction of the drag characteristics for freely rising bubbles led to a nonlinear differential equation which was solved numerically to obtain the relationship between the bubble size and distance traveled. Dissert. Abstr.

N70-42390 National Lending Library for Science and Technology, Boston Spa (England).
THE HYDRODYNAMIC DRAG ON A DISC
V. M. Kapinos Jul. 1970 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. (Moscow), no. 5, 1965 p 155–158
(NLL-RTS-5957) Avail: Natl. Lending Library, Boston Spa, Engl.: 14s; 2 NLL photocopy coupons

A more precise description of the flow pattern over a disk rotating in a housing, with unseparated flow, is derived by means of finitely thick boundary layer theories. Previously obtained approximate solutions are briefly discussed. Author

N70-42394# Royal Aircraft Establishment, Farnborough (England).
STUDY OF WAVE PHENOMENA IN THE STEADY FLOW OF AN INVISCID STRATIFIED FLUID [ETUDE DES PHENOMENES D'ONDES DANS LES ECOULEMENTS STATIONNAIRES D'UN FLUIDE STRATIFIE NON VISQUEUX]
Radyadour Kh. Zeytounian Dec. 1969 109 p refs Transl. into ENGLISH from the French Report
(RAE-LIB-TRANS-1404; ONERA-Publ-126) Avail: NTIS

Equations are written for the problem of a stratified fluid above an obstacle of arbitrary shape. This formulation, in steady regime for an inviscid fluid, takes into account the nonlinear convection phenomena and the vertical accelerations. Different theoretical models are worked out. With these models it is possible to study the wave pattern downstream of an obstacle within a baroclinic atmosphere. Results are given for the flow of a mass of stratified air above irregular ground, and for a three dimensional linearized flow combined with the intersection of a thermal boundary layer with the free inviscid flow. With the computing methods presented it is possible, to obtain, for any arbitrary obstacle shape, the flow configuration above and downstream of this obstacle as a function of the generalized Froude number. Some numerical results are presented. Author

N70-42444 Illinois Univ., Urbana.
STABILIZATION OF THE RAYLEIGH-TAYLOR INSTABILITY WITH MAGNETIC FEEDBACK
Dusan Zrnic (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-1022

Stabilization was studied, both theoretically and experimentally, on a fluid pendulum and on a free interface between two fluids. A container was developed in which only a one dimensional instability occurred while the effects of weight were eliminated. Using long wave approximations, solutions were obtained for natural modes in a narrow rectangular container, with the free surface stuck at the lateral edges. The instability points and the resonant frequencies were computed and found to be in a good agreement with the experiment. A two station A.C. magnetic feedback system was built and successfully applied to stabilize the fluid pendulum. The change in intensity of tangential magnetic fields controlled by the displacement of the fluid was used to exert pressure on the conducting liquid. Ga-In alloy was used as a heavier fluid in contact with a dilute solution of HCl which was a lighter fluid. In the

absence of feedback it was impossible to stabilize the pendulum, while with the inclusion of active feedback as unstable system was transformed into a stable one. Dissert. Abstr.

N70-42448# Stichting voor Fundamenteel Onderzoek der Materie, Utrecht (Netherlands).
DIFFUSION IN NOBLE GAS MIXTURES BETWEEN 300 K AND 1400 K
Willem Hogervorst (Ph.D. Thesis - Utrecht Univ.) Utrecht Univ. 1970 70 p refs Sponsored by Nath. Organ. for Pure Sci. Res.
Avail: NTIS

Measurements of diffusion coefficients in binary rare gas mixtures between 300 K and 1400 K are described. The required concentration gradients were obtained with a dc discharge in the gas. After the discharge had been extinguished the concentration gradients gradually disappeared and the diffusion coefficient was calculated from the time dependence of this remixing process. The transport properties of simple gases are reanalyzed, using recent accurate viscosity measurements, to determine repulsive forces between identical atoms. ESRO

N70-42455# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.
NUMERICAL TRANSFORMATIONS AND INTERPOLATIONS AS A MEANS FOR EVALUATING THE RESULTS OF MEASUREMENTS [NUMERISCHE TRANSFORMATIONEN UND INTERPOLATIONEN ALS HILFSMITTEL BEI DER AUSWERTUNG VON MESSERGEBNISSEN]
Helmut Hardegen Mar. 1970 58 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-14) Avail: NTIS; ZLDI Munich: 12,50 DM

A method is given for interpreting flow measurements by numerical transformation of coordinate systems and interpolation of the results. The transformations are required because the flow components have to be determined for arbitrary points in space, by computation, or vice versa. A few examples and the ALGOL programs are given. ESRO

N70-42466# Douglas Aircraft Co., Inc., Long Beach, Calif.
THE BEHAVIOR OF TURBULENT FLOW NEAR A POROUS WALL WITH PRESSURE GRADIENT
Tuncer Cebeci Sep. 1969 24 p refs
(AD-710435; DAC-70014) Avail: NTIS CSCL 20/4

Van Driests theory, which provides a continuous velocity and shear distribution for turbulent flow near a nonporous wall, is extended to turbulent flow near a porous wall. The new, modified theory enables the theoretical calculation of velocity profiles to be performed for a wider range of mass-transfer rates, and it gives good agreement with experimental data. Author (TAB)

N70-42586# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
METHODS FOR DETERMINING CONDITIONS IN REAL NITROGEN EXPANDING FLOWS
S. Culotta and B. E. Richards Feb. 1970 156 p refs
(VKI-TN-58) Avail: NTIS

Perfect gas table correction factor charts to take into account the real gas effects in the isentropic expansion of nitrogen gas from high density and temperature conditions are presented. Equilibrium thermodynamic properties based on the Culotta-Enkenhus equation of state were used for the calculations. Charts and tables for calculating the stream quantities in the test section of a hypersonic wind tunnel where the density and temperature of the gas are sufficiently low that the gas can be conaidered perfect are also given. A computer program for calculating the real gas conditions in nitrogen expanding from high density and temperature conditions to the Mach number desired, which can be used in the design of a contoured wind tunnel nozzle using the method of characteristics, is also printed. Author (ESRO)

N70-42680 Texas Univ., Austin.
A NUMERICAL SOLUTION FOR PROBLEMS IN LAMINAR GAS DYNAMICS
Winston Douglas Goodrich (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-21818

The equations which describe nonsteady, viscous, laminar, compressible flow of an ideal gas were formulated and solved through the use of an explicit finite difference numerical technique. The general solution procedure requires that problems be formulated as initial value problems which yield steady state solutions as the transient behavior of the flow diminishes. This formulation provides a capability for automatically incorporating flow discontinuities into the general solution procedure. Surface boundary conditions are handled in a consistent and unique manner through the use of a physically oriented extrapolation procedure. Solutions are presented for supersonic flow of air over a flat plate with a sharp leading edge and a flat plate with a rearward facing step. The range of free stream Mach numbers covered in this investigation was from 2 to 10. The free-stream Reynolds number per foot varied upward to 1 million. Dissert. Abstr.

N70-42688# Bergen Univ. (Norway). Dept. of Applied Mathematics.
OSCILLATORY VISCOUS FLOWS IN THE VICINITY OF A CYLINDER
A. Svardal and S. Tjoetta Jun. 1969 19 p refs Submitted for publication
(Rept-17) Avail: NTIS

The two-dimensional non-linear flow of an incompressible, viscous fluid of infinite extent oscillating perpendicular to the axis of a circular cylinder at rest was studied theoretically. New numerical results are compared with earlier experimental ones. Author (ESRO)

N70-42786# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
VORTEX WAKES FROM FLEXIBLE CIRCULAR CYLINDERS AT LOW REYNOLDS NUMBERS
J. R. Date and R. A. Holler 7 Jul. 1970 47 p refs
(AD-710397; NADC-AE-7011) Avail: NTIS CSCL 20/4

The study is related to the flexible circular cylinder in the Reynolds number range from 30 to 500. The shedding features of flexible cables are studied and general characteristics of vortex shedding are interpreted from diagnostic observations. The study has two objectives: (1) to observe and analyze the vortex shedding features characteristic of a flexible cable that is flow-excited into standing wave oscillations; and (2) to perform a diagnostic investigation of the spanwise shedding phenomenon when the vortex shedding is both dependent and independent of the oscillating motion. Author (TAB)

N70-43022# Naval Postgraduate School, Monterey, Calif.
THE EFFECT OF VARYING SECONDARY STAGNATION TEMPERATURE AND MOLECULAR WEIGHT ON THE SIDE FORCE GENERATED BY GASEOUS INJECTION INTO A SUPERSONIC STREAM
Russel Allen Chambers (M.S. Thesis) Oct. 1969 50 p refs
(AD-710364) Avail: NTIS CSCL 20/4

The study was undertaken to investigate the effects of varying the injectant temperature and molecular weight on the flow field generated by the interaction of a secondary jet with a supersonic mainstream. The experimental portions of this investigation were conducted at a primary Mach number of 1.92. Data are presented and compared with theory. The presentation includes correlation of the penetration height of the secondary flow.

interaction side force amplification factor, and separation distance non-dimensionalized with respect to the penetration height. Author (TAB)

N70-43047*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
OPTICAL MEASUREMENT OF MULTIPLUME INTERACTION Final Report
C. E. Craven Jan. 1970 832 p refs
(Contract NAS8-21285)
(NASA-CR-102890; LMSC/HREC-D162004; HREC-1285-1) Avail: NTIS CSCL 20D

A test program was conducted on a model Saturn 2-type clustered nozzle configuration (four and five nozzles), to obtain detailed experimental data on the flowfield characteristics in the base flow region. The effort performed on this contract involved measuring and interpreting flow field parameters for the test program. Conventional measuring techniques such as pressure instrumentation, hot-wire anemometry, and various flow visualization schemes were used. An attempt was made to use a laser doppler velocimeter to measure the mean flow velocity within the recirculation region. In order to show the feasibility of the velocimeter to measure mean velocities in turbulent supersonic flow testing was also performed in a 7-inch supersonic tunnel. Efforts and results associated with the laser velocimeter feasibility work are described. Author

N70-43101*# Advanced Technology Labs., Inc., Jericho, N.Y.
THREE DIMENSIONAL MIXING OF JETS
Edgar Alzner Jul. 1970 45 p
(Contract NAS1-9560)
(NASA-CR-111782; ATL-TR-150) Avail: NTIS CSCL 20D

An analysis of the diffusion process in the region where adjacent injectors interact is presented for scramjet combustion chamber design. Two specific problems are investigated: one dealing with jets or sets of jets with no sweepback and containing only planes of symmetry, and the other with jets or sets of jets with sweepback and containing planes of symmetry and also planes of equivalence. N.E.N.

N70-43131 National Lending Library for Science and Technology, Boston Spa (England).
THE SPRAY PATTERN OF AEROSOL PRODUCTS
W. Lessenich 29 May 1970 10 p Transl. into ENGLISH from Seifen-Oele-Fette-Wachse (Augsburg), v. 87, no. 8, 1961 p 182–184 Presented at the Meeting of the Ges. Deutscher Kosmetikchemiker, Frankfurt am Main, 11 Mar. 1961
(NLL-M-9160-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Aerosol spray patterns are studied. Factors affecting the pattern include: (1) the ratio of the amounts of active material to propellant, (2) the vapor pressure of the propellant, and (3) the construction of the valve and the nozzle. Results showing the influence of these factors are graphed. It is concluded that the aerosols floating in the air of a room can be obtained only with a high proportion of propellant, while the vapor pressure and the form of the valve have practically no influence on the fineness of the spray, and in the ratios of the amounts of active material solution to propellant for cosmetic aerosol products, the vapor pressure of the propellant affects the spray pattern less than the form of the valve. F.O.S.

N70-43192*# Southwest Research Inst., San Antonio, Tex.
A COMPUTER PROGRAM FOR FUEL SLOSHING IN AN AXISYMMETRIC TANK
W. H. Chu, R. Gonzales, A. F. Muller, and D. R. Soathoff Aug. 1970 82 p refs
(Contract NAS8-20290; SwRI Proj. 02-1846-02)
(NASA-CR-102889; TR-10) Avail: NTIS CSCL 20D

The generation of a nonuniform triangular mesh and the sequence of calculations used in the TRIPOT computer program for fuel sloshing in an axisymmetric tank are described. A finite difference technique using a triangular mesh was used to solve the potential flow equations. The SSHAPE program computed the equilibrium free surface shape of the liquid. The output of SSHAPE was included in the input for TRIPOT. Instructions for using both TRIPOT and SSHAPE programs are outlined. A program for generation of the interface shape and associated quantities is appended as well as a theory for low-gravity fuel sloshing in an arbitrary axisymmetric rigid tank, numerical examples, and listings and input samples of both TRIPOT and SSHAPE. J.M.

N70-43196# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
CHARACTERISTICS OF A HEATED JET DISCHARGED HORIZONTALLY INTO A TRANSVERSE CURRENT. PART 1: CONSTANT DEPTH
H. H. Carter Nov. 1969 40 p refs
(Contract AT(30-1)-3109)
(NYO-3109-48; Ref-69-14; TR-14) Avail: NTIS

Results of investigations concerning the behavior of heated discharges of water jetted at right angles into a moving streams of water are presented. The discharge canal is rectangular. The jet stream and the receiving waters are confined vertically by the sea surface and the sea bottom. A mathematical analysis of the results is included. NSA

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N70-41805*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THICKNESS OF IMPACT CRATER EJECTA ON THE LUNAR SURFACE
Nicholas M. Short and Michael L. Forman Sep. 1970 80 p refs Submitted for publication
(NASA-TM-X-65350; X-652-70-336) Avail: NTIS CSCL 03B

Calculations based on improved models for impact cratering indicate an average thickness (if spread uniformly) of ejecta from craters and basins between 2 and 500 km diameters on the visible face of the moon that ranges from 0.74 to 8.00 km (best estimate values between 1.36-2.39 km), depending on combinations of critical parameters utilized. These parameters include: (1) initial effective diameters of craters of excavation, (2) depth/diameter ratios between 0.05 and 0.35, (3) fractional enlargement of diameters by slumping (from zero to 50%), (4) efficiency of ejection, (5) frequency distribution of craters in the size range used, and (6) appropriate selection of circular structures as impact-generated. Chief uncertainty is the identification of those large basins definitely caused by impact; where mare-filled, the proper choice of diameter becomes critical. Contributions from mascon-related basins versus all roughly circular basins are treated separately. The general thinness of rubble cover (approximately 1–20 meters) on some mare surfaces implies that most major craters were formed early in lunar history. An anorthositic lunar highlands (indicated by Apollo 11 results) should be covered to varying depths with ejecta derived largely from impact basins cut into a pre-mare crust that was continuous around the lunar sphere. Author

N70-41867# Coast Guard, Washington, D.C. Applied Technology Div.
BIBLIOGRAPHY OF MARITIME SEARCH THEORY AND BACKGROUND MATERIAL ON OPERATIONS RESEARCH Interim Bibliography
Virgil L. Banowetz 17 Jul. 1970 11 p refs
(AD-709237) Avail: NTIS CSCL 12/2

The items in this bibliography relate, in various degrees, to the operations research of planning a maritime search. The list is neither exhaustive nor very centrally related. Some of the references have been studied at this office. Limited assistance may be requested here for obtaining most of them. There is no order to list but an alphabetical list by author referring to the item number is included. (Author) TAB

N70-41874+ Ecole Normale Superieure, Paris (France). Lab. de Physique.
SEISMIC STATION EFFICIENCY RELATED TO IRREGULARITIES OF THE MOHO LAYER Final Scientific Report
Yves Rocard and Pierre Mechler Jun. 1970 13 p
(Contract AF 61(052)-962; Proj. Vela-Uniform)
(AD-708843; AFOSR-70-1933TR) Avail: NTIS CSCL 8/11

In the report are given results obtained by ALPENS seismological staff during the two following studies: Refraction profiles through Sicily (E-W) giving the value of velocity versus depth. In particular, the investigators put into evidence the existence of a low velocity channel inside the earths crust. Structure of the Moho-discontinuity under ALPENS stations in Morvan (France) giving a map of this doscontinuity as it is deduced from the travel time anomalies. Author (TAB)

N70-41987# Space Disturbances Lab., Boulder, Colo.
OBSERVATIONS OF IONOSPHERIC DISTURBANCES IN ANTARCTICA DURING 1968
John E. Jones Feb. 1970 33 p refs
(ESSA-TR-ERL-153-SDL 12) Avail: SOD $0.40

A description of an experiment to observe the structure of radio echoes from the Antarctic ionosphere during 1968, and a study of the effects of traveling ionospheric disturbances are given. A 6-MHz CW signal transmitted from South Pole Station was received at Byrd, McMurdo, and Plateau Stations. Fluctuations in the received frequency were recorded by the Doppler method. Various features observed in the records are explained by ionospheric models involving electron drifts and atmospheric waves. Author

N70-41988# Institute for Telecommunication Sciences, Boulder, Colo.
GROUND WAVE PROPAGATION IN AN IONIZED ATMOSPHERE WITH ARBITRARY VARIATION OF THE CONDUCTIVITY WITH ALTITUDE
J. Ralph Johler Mar. 1970 28 p refs
(ESSA-TR-ERL-163-ITS 105) Avail: SOD $0.35

The atmosphere can apparently be ionized to such a degree that the ground wave is disturbed as a result of, for example, a nuclear event, and ionizing radiation of sufficient intensity to overcome the ion-ion recombination processes may cause the ions to accumulate near the surface of the ground. Gamma radiation from the fallout of a nuclear weapon may produce such ionization for a considerable time after the nuclear event. A theoretical approach to such ground wave problems based on methods of numerical analysis was developed for computer application. The computer computation concept is discussed, and sample computations based on the fallout model profile are presented. A particular fallout model based on data given in the U. S. Atomic Energy Commission's handbook on The Effects of Nuclear Weapons is considered in some detail, and the effect of an ionization profile (ion number density as a function of altitude) on the propagation of the ground wave is ascertained. A physically possible but not likely extra attenuation of 12 db at 100 km distance is noted. Author

N70-42011*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
ATMOSPHERIC TRANSMISSION IN THE REGION FROM 16.75 TO 20.95 MICROMETERS
W. L. Raine, S. M. Landrum, and M. W. Segewitz Jul. 1970 30 p refs
(Contract NAS8-25166)
(NASA-CR-102875; TN-SE-300) Avail: NTIS CSCL 04A

Preliminary solar spectrum observations covering the region from 16.75 to 20.95 micrometers under low resolution were taken at a site on Bigelow Mountain, Arizona. These observations were analyzed for the selective atmospheric transmission in the interval. From these data, transmission coefficients were deduced which allow calculation of the selective transmission for various band model approximations. The fit of the observations to the various band model approximations was also numerically evaluated throughout the region. Author

N70-42012# Geological Survey, Washington, D.C.
GRAVITY AND MAGNETIC ANOMALIES IN THE SODA SPRINGS REGION, SOUTHEASTERN IDAHO
Don R. Mabey and Steven S. Oriel 1970 38 p refs *Its* Professional Paper 646-E
Avail: SOD

Two major gravity lows indicate deeply filled troughs in Gem and Bear Lake Valleys in the western, block-faulted part of the Soda Springs region. A third large and compound gravity low at China Hat may record an igneous collapse structure, but the evidence is equivocal. In contrast, the relatively uniform gravity values in the eastern, mainly folded, part of the region indicate little detrital fill in strike valleys in the folded and thrust belt. Gravity data also indicate that variations in regional topography in the surveyed area are isostatically compensated but that the region in general is undercompensated. All but two of the aeromagnetic anomalies are attributable to surface volcanic features and to structures inferred therefrom. The magnetic anomalies indicate the distribution and thicknesses of basaltic rocks. The largest anomalies, north of Niter, west of Grace, and north-northwest of China Hat, are associated with vents and craters, and these may be guides to concealed related intrusive bodies. Author

N70-42044*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
REMOTE SENSING APPLICATIONS IN FORESTRY: THE DEVELOPMENT OF AN EARTH RESOURCES INFORMATION SYSTEM USING AERIAL PHOTOGRAPHS AND DIGITAL COMPUTERS Annual Progress Report
Philip G. Langley, David A. Sharpnack, Robert M. Russell, and Jan Van Roessel 30 Sep. 1969 49 p refs Prepared in cooperation with California Univ., Berkeley
(NASA Order W-12996)
(NASA-CR-114121) Avail: NTIS CSCL 02F

A preliminary systems analysis was completed specifying the equipment and software packages needed to build the information processing, storage and retrieval systems. Programs were written for (1) the conversion of coordinate data from the map digitizer to FORTRAN accessible form, (2) the thinning of coordinate data, and (3) the closing of boundaries. A systems analysis and program development are completed for testing image matching procedures to be used for the automatic mapping of forest resources using digitized stereopairs of aerial photographs. Also, a program package for simulating scanned aerial photographs in various orientations was written to test the effects of the three-directional rotations on digital image matching procedures. Author

N70-42064# Geological Survey, Washington, D.C.
TECTONICS OF THE MARCH 27, 1964 ALASKA EARTHQUAKE
George Plafker 1969 185 p refs *Its* Professional Paper 543-I
Avail: SOD

The observed and inferred tectonic displacements that accompanied the earthquake resulted primarily from relative seaward displacement and uplift of the seaward part of the block by

movement along the dipping megathrust and subsidiary faults that break through the upper plate to the surface; and simultaneous elastic horizontal extension and vertical attenuation (subsidence) of the crustal slab behind the upper plate. Regional vertical deformation generated a train of destructive long-period seismic sea waves in the Gulf of Alaska as well as unique atmospheric and ionospheric disturbances that were recorded at points far distant from Alaska. Warping resulted in permanent tilt of larger lake basins and temporary reductions in discharge of some major rivers. Uplift and subsidence relative to sea level caused profound modifications in shoreline morphology with attendant catastrophic effects on the nearshore biota and costly damage to coastal installations. Author

N70-42086# Defence Scientific Information Service, Ottawa (Ontario).
VARIATION OF THE MAIN GEOMAGNETIC FIELD IN THE DRIFT-REGION OF STATION NORTH POLE 13 IN 1965-1966
R. M. Gaikin May 1970 3 p Transl. into ENGLISH from Probl. Arktiki Antarktiki, Sb. Statei (Leningrad), no. 28, 1968 p 146-147
(AD-709295; T-534-R) Avail: NTIS CSCL 20/3

From April 1965 through April 1966 Station North Pole 13 was drifting in the area bounded by latitudes 78-82 deg. N and longitudes 133-167 deg. E. In that year the ice field on which the station was located traveled a straight-line of 800 km in a general WNW direction, drifting over the continental shelf, the deep ocean, and finally crossing the Lomonosov Ridge. During the whole year, repeated measurements of the geomagnetic vertical component were made, in order to determine the anomalic geomagnetic field variations in regions of different ocean floor relief. Author (TAB)

N70-42098# National Oceanographic Data Center, Washington, D.C.
RELIABILITY STUDY OF MECHANICAL BATHYTHERMOGRAPHS Technical Bulletin
Sep. 1970 4 p
(RN-1003) Avail: Issuing Activity

The performance tests on the effects of repeated cycling on the accuracy and reliability of mechanical bathythermographs (BT's) are presented. The data showed the following results concerning the reliability of the depth and temperature measurements: (1) The depth accuracy of BT's deteriorates with usage. The rate is large initially and then appears to level off to nearly an asymptotic value. (2) The depth accuracy of instruments after use aboard ships is considerably less than that of new, and refurbished BT's. (3) Temperature data for individual BT's is consistent and exhibits very little variance. (4) The absolute value of the average and the maximum temperature errors are normally distributed. The results are summarized. F.O.S.

N70-42117# Environmental Science Services Administration, Boulder, Colo. Earth Sciences Labs.
SCIENTIFIC AND TECHNICAL PUBLICATIONS, 1 JULY 1968-30 JUNE 1969
Mar. 1970 24 p refs
Avail: Issuing Activity

Research activities on the measurement and analysis of geomagnetic fields and on earth structure and earthquake mechanism are reported. The magnetic research emphasized paleomagnetic determinations and especially intensity measurements before, during, and after a field reversal, with the aim of predicting the future geomagnetic field. Macrotemporal variations, micropulsations and field variations, and mathematical modeling of the magnetic field are discussed. The seismology research included monitoring the active San Andreas Fault and studying piezomagnetic effects associated with the fault. Basic research directed toward understanding earthquake mechanism and seismic wave propagation related to global tectonics is described. Results support the idea that plates of lithosphere sink into the asthenosphere as a result of body forces on excess mass in the plates, and that the underthrusting of the Pacific plate beneath South America is in an E-ENE direction. N.E.N.

N70-42122# Coast and Geodetic Survey, Rockville, Md.
UNITED STATES EARTHQUAKES, 1967
Carl A. von Hake, William K. Cloud, and Jerry L. Coffman, ed. 1969 94 p
Avail: SOD $1.25

A summary of earthquake activity in the United States and regions under its jurisdiction for the calendar year 1967 is presented. The sources of noninstrumental information used in the compilation include the U.S. Weather Bureau whose observers prepare periodic reports on local seismic activity; telegraphic information collected by Science Service, Washington, D.C.; bulletins of the Seismological Society of America; special reports of various institutions; newspaper clippings; and reports from interested individuals. Instrumental data used in locating earthquakes are obtained from seismological observatories and cooperating seismological stations located throughout the United States. Author

N70-42142# Department of Agriculture, Washington, D.C. Forest Service.
LAND RESOURCE INVENTORY AND ENGINEERING SURVEYS USING PHOTOGRAMMETRY Engineering Technical Report
John R. Swinnerton Aug. 1970 26 p Reprinted
(ETR-7100-2) Avail: Issuing Activity

Land resource management plans for the national forests, based on the multiple use concept, has made it necessary to obtain accurate and comprehensive land inventory surveys. A project is reported aimed at the application of new techniques and procedures to forest land resource inventory, engineering surveys and design, and automated mapping. Techniques include the use of color photography, analytical bridging and block adjustment multi-scale control extension, and the use of the electronic computer and the electronic coordinatograph. A total systems approach is described and the progress in its utilization is outlined. D.L.G.

N70-42144# Air Force Cambridge Research Labs., Bedford, Mass.
ARCTIC IONOSPHERE AND AURORA: AIRBORNE INVESTIGATIONS
J. Buchau, E. W. Pittenger, and A. W. Sizoo May 1970 62 p refs *Its* AFCRL-ERP-322
(AD-709359; AFCRL-70-0280) Avail: NTIS CSCL 4/1

In response to Air Force needs for specifying and forecasting conditions of the Arctic ionosphere, AFCRLs Airborne Ionospheric Laboratory, a highly instrumented NKC 135 jet aircraft, was used in an extensive Arctic research program that started in 1967. To date, 69 flights were made and ionospheric and optical data covering major parts of the auroral oval, mainly the midday sector and the night sector, were collected. During the winter months of 1967, 1968, 1969, and 1970 special emphasis was put on the investigation of the day sector. These flights covered a rather unique and poorly investigated area of the auroral oval, and a detailed report on the observations is given here. A thorough analysis of the data collected in the day sector reveals the existence of a band of continuous particle precipitation south of the location of the discrete aurora. This precipitation hardens towards the south and results in E- and D-region ionization. These observations compare very well with measurements of precipitating particles done by satellite. The investigation of the evening and night sectors showed similar but less organized trends than on the day side. During several flights the continuity of the auroral oval was verified. The investigation indicates that, with additional measurements, it may be possible to develop a model of the Arctic ionosphere. With control measurements from a few ideally located ground stations, the dynamics of the Arctic ionosphere might then be utilized for forecasting propagation conditions in the Arctic. Author (TAB)

N70-42145# Air Force Cambridge Research Labs., Bedford, Mass.
TIME SYNCHRONIZATION OF PRIMARY GEODETIC SITES THROUGH USE OF ARTIFICIAL SATELLITE
John C. Herring, Darwin G. Abby, and Jack A. Cook Jun. 1970 20 p refs *Its* AFCRL-AFSG-220
(AD-709360; AFCRL-70-0333) Avail: NTIS CSCL 8/5

Geodetic measuring techniques, especially those making use of the artificial satellite, have advanced to the point where timing requirements once fulfilled by such systems as WWV no longer can provide the accuracies currently required. Geodetic field teams, dispersed on a worldwide basis, have in their inventory time standards ranging from crystal oscillators to cesium beam standards. Each must be synchronized to some basic standard. The advent of the synchronous communications satellite has provided the geodetic community and others with a real time, economical and highly precise means of synchronizing these same time standards. One such technique utilizing these communications satellites as a link in the synchronization process is reviewed. Author (TAB)

N70-42159*# Oregon State Univ., Corvallis. Dept. of Chemistry.
ELEMENTAL ABUNDANCES IN METEORITIC AND TERRESTRIAL MATTER Annual Progress Report, 1 Sep. 1969 – 31 Aug. 1970
Roman A. Schmitt 31 Aug. 1970 28 p refs
(Grant NGL-38-002-020)
(NASA-CR-114230) Avail: NTIS CSCL 08G

Seven main studies were actively pursued: (1) The first investigation was directed toward determination of the elemental composition of selected elements in basaltic specimens from central Oregon and south central Washington. (2) A program was directed toward the determination of aluminum via INAA (instrumental neutron activation analysis) in approximately 550 individual chondrules separated from 28 meteorites, which represent different petrographic grades. In these same studies, the element Fe was determined in some 60 chondrules by INAA. (3) Abundances of the 14 rare earth elements plus In and K were determined via RNAA (radiochemical neutron activation analysis) in a composite 12-chondrite sample. (4) About 100 chondrules were separated from several Allende fragments. (5) Experimental studies commenced for the separation of chondritic minerals in order to investigate partitioning of trace elements in a variety of chondritic meteorites. (6) Preliminary work began on the analysis of Ca-poor achondrites. (7) Studies of elemental abundances of the 14 rare earth elements in pallasitic olivine were started. Author

N70-42184*# California Univ., San Diego. Visibility Lab.
ATMOSPHERIC LIMITATIONS ON REMOTE SENSING OF SEA SURFACE ROUGHNESS BY MEANS OF REFLECTED DAYLIGHT Final Report
S. Q. Duntley, C. F. Edgerton, and T. J. Petzold Sep. 1970 118 p refs
(Contract NAS12-2126)
(NASA-CR-73479; SIO-REF-70-27) Avail: NTIS CSCL 04A

A study of the limitations imposed by the earth's atmosphere on optical remote sensing of sea surface roughness from satellites and orbital spacecraft is presented. It is concerned with the optical and meteorological conditions at a single ocean location and in the near infrared region of the spectrum. There is a detailed description of the instrumentation used to make ground-based measurements of optical atmospheric data. The optical system, electronics, photocell circuit, and calibration procedures are defined. Author

N70-42193*# Scientific Translation Service, Santa Barbara, Calif.
ANISOTROPISM OF S-WAVE IN DUNITE [DUNITE NO S-HA IHOSEI]
J. Kasahara et al Washington NASA Oct. 1970 12 p refs Transl. into ENGLISH from Jishin (Tokyo), v. 21, 1968 p 229 – 236
(Contract NASw-2035)
(NASA-TT-F-13322) Avail: NTIS CSCL 08G

Shear wave velocity of Hidaka Horoman dunite (HD 20 A) was measured. Fabrics of two shear velocities at the same path, V sub S1, V sub S2, velocity difference, Delta V sub S = V sub S1 – V sub S2 and particle motion are shown. These fabrics are closely related to fabrics of compressional wave velocity and preferred orientation of olivine. Maximum shear velocity is 4.86 km/s and minimum one is 4.54 km/s. Maximum velocity difference is 0.34 km/s. Author

N70-42206*# Stanford Univ., Calif. Inst. for Plasma Research.
SOME STUDIES OF TRIGGERED WHISTLER EMISSIONS
K. B. Dysthe Aug. 1970 41 p refs
(Grant NGL-05-020-176)
(NASA-CR-114262; SU-IPR-383) Avail: NTIS CSCL 04A

The effects of a nonlinear interaction between a whistler wave and the particles resonating with it are considered in some detail. The interaction gives rise to two closely related effects, namely a change in the amplification or absorption by the plasma, and a phase-bunching of the resonant and near-resonant particles, giving rise to a current. The current due to the phase-bunched particles has roughly the same structure (frequency and wave number) as the wave causing it, and will therefore give rise to emission of a new whistler wave, acting like an antenna. The possibility of having a self-sustained process of phase-bunching and emission is investigated. The structure of a region where this process can take place is proposed, and the corresponding conditions that have to be met are stated. Author

N70-42226# Naval Research Lab., Washington, D.C.
THE REMOTE SENSING OF OIL SLICKS BY RADAR
N. W. Guinard and C. G. Purves 1 Jun. 1970 35 p refs
(AD-709982) Avail: NTIS CSCL 13/2

The NRL Four Frequency Radar System, at Coast Guard request, was flown over the oil slick caused by the wreck of the tanker Arrow in the Chedabucto Bay area of Nova Scotia on 17 February 1970. The oil slick was mapped remotely from an EC-121 aircraft in both the horizontal and vertical polarizations. Synthetic aperature imagery was obtained in the P, X, L and C-band. This data clearly established the value of the radar sensing techniques as a tool for locating and monitoring oil spills. Author (TAB)

N70-42234*# Southwest Center for Advanced Studies, Dallas, Tex.
PALEOMAGNETIC EVIDENCE FOR THE ROTATION OF ALASKA
Charles E. Helsley [1970] 21 p refs *Its* Contrib. No. 104
(Grants NGL-44-004-001; NSF GP-2205; NSF GA-590; NSF GA-1304)
(NASA-CR-110778) Avail: NTIS CSCL 08G

The remanent magnetization of two suits of Cretaceous lavas collected from central Alaska indicates a rotation of Alaska relative to North America of at least 20 degrees since the early Cretaceous. The amount and sense of rotation is consistent with the orocline hypothesis of Carey (1958) and with current ideas regarding the opening of the Arctic Basin and Atlantic Ocean. Author

N70-42235*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
[AGRICULTURAL APPLICATIONS AND REQUIREMENTS PROGRAMS] Quarterly Progress Report, 1 Apr. – 30 Jun. 1969
30 Jun. 1969 81 p
(NASA Order W12-996; Contract USDA-12-14-100-9549(20))
(NASA-CR-110780; QPR-3) Avail: NTIS CSCL 08F

Discussions were held during this quarter with numerous scientists in various disciplines of the natural sciences. Interest centered around the potential use of LARS techniques and facilities for research in geology, limnology, meteorology, ecology, geography, and civil engineering. Soil scientists associated with LARS and the

Purdue University Department of Agronomy conferred with soil scientists of the Indiana Office of the Soil Conservation Service concerning methods of evaluating the use of multispectral data in surveying and mapping soils. Several factors were proposed for evaluating the utility of computer printouts which separate soils according to the spectral properties of the surface. Author

N70-42236*# Southwest Center for Advanced Studies, Dallas, Tex.
REMANENT MAGNETIZATION OF THE PERMIAN CUTLER FORMATION OF WESTERN COLORADO
Charles E. Helsley [1970] 19 p refs *Its* Contrib. No. 105
(Grants NGL-44-004-001; NSF GP-2205; NSF GA-590; NSF GA-1304)
(NASA-CR-110779) Avail: NTIS CSCL 08G

The early paleomagnetic observations from the Permian of the Western United States were not subjected to demagnetization studies. Observations on the Lower Permian Cutler Formation of western Colorado suggest that many of these older poles are in error by 10 or more degrees. The new pole from the Cutler Formation at 42.7N 121.9E is virtually identical with the demagnetized results from Eastern North America and provides an excellent test of the dipolar hypothesis. The results emphasize the need for additional study of the older paleomagnetic data for North America. Author

N70-42239# Naval Oceanographic Office, Washington, D.C.
ON THE METHODS OF DETERMINING ICE DRIFT FROM VESSELS [O METODAKH SUDOVYKH OPREDELENII DREIFA LDA]
V. L. Tsurikov 1970 28 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst., (Moscow), no. 40, 1957 p 132–146
(AD-709323; NOO-TRANS-191) Avail: NTIS CSCL 8/12

Methods used in the calculation of the direction and speed of ice drift are divided into two groups: those carried out from aboard (1) anchored and (2) drifting vessels. They include: the sighting of drifting ice floes and determination of distances to them with the aid of azimuth circle, the use of lead line thrown on drift ice, navigational method with the aid of coastal objects, radar and radar sightings, as well as the astronomical method. The accuracy of results, simplicity and convenience in carrying out the calculations are analyzed, compared and evaluated, taking into consideration the ice and weather conditions the required degree of precision, the speed of determination and the available personnel and technical means. Author (TAB)

N70-42250# National Oceanographic Data Center, Washington, D.C.
ANNOTATED ACRONYMS AND ABBREVIATIONS OF MARINE SCIENCE RELATED INTERNATIONAL ORGANIZATIONS
Jeannette P. North, comp. 1969 130 p refs
(AD-704940; NODC-PUB-G-18) Avail: NTIS CSCL 5/2

Only international organizations are included. The alphabetical order is based on the acronym/abbreviation. The text supplies the date of establishment or founding, briefly the aims or objectives of the organization or project, its membership, any literature published and, where possible, the current mailing address of each. Author (TAB)

N70-42276*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE 1969 SMITHSONIAN STANDARD EARTH AND GLOBAL TECTONICS
E. M. Gaposchkin, W. M. Kaula, and K. Lambeck Sep. 1970 52 p refs
(Grants NGR-09-015-002; NSF GA-10963)
(NASA-CR-114254) Avail: NTIS CSCL 08E

Geodetic parameters describing the earth's gravity field and the positions of satellite tracking stations in a geocentric reference frame were computed. The parameters were estimated from a combination of four different types of data: routine and simultaneous satellite observations, observations of deep-space probes, and surface gravimetry. The global gravity field is represented by spherical harmonics complete to degree and order 16, plus a number of coefficients to which satellites are sensitive, a resolution of about 11 deg or 1200 km. The accuracy is established primarily by intercomparison. The coordinates of 12 fundamental stations are known to + or − 10 m or better, and those of 39 stations (or groups of collocated stations) are known to + or − 20 m or better. The accuracy of the global field is + or − 3 m in geoid height, or + or − 9 mgal. The solution leads to a new understanding of global tectonics and geodynamics. It shows ocean rises, as well as trench and island arcs, as mass excesses. Ocean basins, areas of recent glaciation, and the Asian portion of the Alpine belt are mass deficiencies. Most features appear to be the result of varying behavior of the lithosphere in response to asthenospheric flow. Author

N70-42281# Oregon State Univ., Corvallis. Dept. of Oceanography.
HYDROGRAPHIC DATA FROM OREGON WATERS, 1969
Bruce Wyatt, William Gilbert, Louis Gordon, and Dennis Barstow Jun. 1970 160 p refs Supported in part by Bur. of Com. Fisheries
(Contract N00014-67-A-0369-0007; Grants NSF GA-1281; NSF GA-12113; NSF GA-1435)
(AD-710004; DATA-42; REF-70-12) Avail: NTIS CSCL 8/10

Salinity, temperature, oxygen, phosphate, and nitrate observations were taken by Oregon State University on 16 hydrographic cruises in the Northeastern Pacific Ocean during 1969. Alkalinity, pH and silicate were taken on special occasions. Nine cruises were taken along the Newport line. The rest were special cruises made off Depoe Bay, Oregon, in the Columbia River plume, and off Peru. Author (TAB)

N70-42290 Cornell Univ., Ithaca, N.Y.
AN APPLICATION OF STEREO AERIAL PHOTOGRAPHS TO THE ESTIMATION OF DISCHARGE PROPERTIES OF DRAINAGE BASINS
Steven Istvan Majtenyi (Ph.D. Thesis) 1969 327 p
Avail: Univ. Microfilms: HC $14.85/Microfilm $4.20 Order No. 69-20985

A method was developed for the preliminary investigation of long term discharge properties of small drainage basins. The analysis is based upon the interpretation of aerial photographs and the records of climatic conditions. The aerial photographs offer qualitative and quantitative data which reflect the long term discharge properties of drainage basins. The qualitative analysis identifies measurable elements used in the quantitative analysis and it also describes conditions in the drainage basin which may alter the discharge properties predicted by the theory. The quantitative analysis consists of the determination of the drainage density and the evaluation of the long term climatic conditions. These factors are applied in the development of parameters for the prediction of discharge. Dissert. Abstr.

N70-42309# Naval Oceanographic Office, Washington, D.C.
THE OCEANOGRAPHIC CONDITIONS OF SEA AREAS ALONG THE COAST OF EL SALVADOR [DIE OZEANOGRAPHISCHEN VERHAELTNISSE DES MEERESRAUMES VOR DER KUESTE EL SALVADORS]
H. G. Gierloff-Emden 1970 15 p refs Transl. into ENGLISH from German Rept., 1959
(AD-709311; NOO-TRANS-166) Avail: NTIS CSCL 8/3

The greatest part of the Pacific coast of Middle America from Mexico to Costa Rica, and thereby of El Salvador, lies in the trade wind belt with purely westerly currents. Therefore, these

currents, as part of the North Equatorial Currents, are westerly for the entire year and are constant and durable. The hydrographic structure of this region is described and presented in six vertical cross-sections: current velocity, temperature, salinity, oxygen, phosphate and suspended particles. Essentially used as a basis for this study are the observations made on the research ship ALBATROSS in 1947. Author (TAB)

N70-42338# Colorado State Univ., Fort Collins.
LABORATORY SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER
J. E. Cermak 1 Jul. 1970 13 p refs Presented at 3d Fluid and Plasma Dyn. Conf., Los Angeles, 29 Jun.–1 Jul. 1970 *Its* Paper No. 70-751
(Contract N00014-68-A-0493-0001; Proj. Themis)
(AD-710250) Avail: NTIS CSCL 4/1

Similarity criteria are given for micro-, small-, and meso-scale motion of the atmospheric boundary layer. Requirements for simulation of dispersion of passive contaminants in the atmosphere are discussed. The characteristic features of a unique meteorological wind tunnel having a capability for simulating thermally stratified boundary layers are described. Mean wind speed, mean temperature and turbulence statistics measured in this laboratory facility are found to be similar to corresponding data obtained from measurements in the atmosphere. Examples of simulated dispersion over a variety of surface features including urban areas and complex topography are described. Author (TAB)

N70-42345# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Mar. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE Bulletin Mensuel, Mars 1970]
1970 30 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for March 1970. ESRO

N70-42363*# Texas Univ., Dallas. Div. of Atmospheric and Space Sciences.
INVESTIGATIONS INTO THE MECHANISM AND RATES OF ATMOSPHERIC MIXING IN THE LOWER THERMOSPHERE Semiannual Status Report
15 Sep. 1970 44 p refs
(Grant NGL-44-004-026)
(NASA-CR-114248) Avail: NTIS CSCL 04A

Research progress is reported on the heat budget and oxygen transport, nonlinear processes in the propagation of internal gravity waves, atomic oxygen measurements below 100 km, and transport processes in the lower thermosphere. R.B.

N70-42376# Bonn Univ. (West Germany). Physikalisches Inst.
MEASUREMENTS OF THE NITROGEN, ARGON, AND HELIUM NUMBER DENSITIES IN THE LOWER THERMOSPHERE ABOVE SARDINIA IN AUTUMN 1967 [MESSUNGEN DER STICKSTOFF-, ARGON- UND HELIUMPARTIALDICHTEN DER UNTEREN THERMOSPHAERE IM HERBST 1967 UEBER SARDINIEN]
W. Bitterberg and D. Offermann Jun. 1970 51 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-30) Avail: NTIS; ZLDI Munich: 10,30 DM

The nitrogen, argon, and helium number densities in the lower thermosphere were measured by means of mass spectrometers in ESRO rocket payloads launched in October 1967 from Sardinia to altitudes between 135 and 205 km. The nitrogen densities were among the highest ever measured at those altitudes, but the argon densities were low by comparison with published results. Helium number densities exceeded the corresponding CIRA values by factors from 1.5 to 3. In contrast with the results from other experiments in these flights, helium was found to be in diffusive equilibrium with the other constituents of the atmosphere. Author (ESRO)

N70-42389*# California Univ., Berkeley. Forestry Remote Sensing Lab.
REMOTE SENSING APPLICATIONS IN FORESTRY Quarterly Progress Report, 1 Oct.–31 Dec. 1969
31 Dec. 1969 52 p refs
(NASA Order W-12996)
(NASA-CR-110794) Avail: NTIS CSCL 02F

Work performed and in progress is reported for each of the following studies: analysis of remote sensing data for evaluating wildland resources; the use of space photography for classifying forest and non-forest land and for detecting forest disturbances; inventory of native vegetation and related resources from space photography; identification and quantification of herbland and shrubland vegetation resources from aerial and space photography; comparative merits of multispectral, line scan data and aerial photography for the analysis and mapping of range resource features in selected shrub steppe and pinyon/juniper woodland ecosystems; vigor loss in conifers due to dwarf mistletoe; development of spectro-signature indicators of root disease on large forest areas; remote sensing of changes in morphology and physiology of trees under stress; use of multispectral sensing techniques to detect ponderosa pine trees under stress from insect or pathogenic organisms; and development of an earth resources information system using aerial photographs and digital computers. P.A.B.

N70-42397*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE BEHAVIOR OF THE IONOSPHERE ABOVE WALLOPS ISLAND DURING THE ECLIPSE OF 7 MARCH 1970
J. E. Jackson and C. J. McQuillan Oct. 1970 27 p refs
(NASA-TM-X-65369; X-625-70-394) Avail: NTIS CSCL 04A

The variation of the ionospheric electron density during a solar eclipse was investigated using ionograms. Comparison of the normalized densities at fixed heights to the obscuration function indicates that 7 percent of the total ionizing flux was of coronal origin and that more flux originated from the Eastern half of the sun than from the Western half. The results are consistent with the East-West solar scans of a radio observatory. The normalized densities were also compared to the theoretical prediction made prior to the eclipse. The difference between prediction and observation is due partly to the uniform disk radiation assumed in previous investigation. Author

N70-42411# Institut d'Aeronomie Spatiale de Belgique, Brussels.
INFRARED COOLING BY ATOMIC OXYGEN IN THE THERMOSPHERE
G. Kockarts 1970 26 p refs Presented at the Intern. School of Atmospheric Phys., Erice, Italy, 15–29 Jun. 1970 Submitted for publication *Its* Aeronomica Acta No. A-74-1970
Avail: NTIS

The atomic oxygen emission at 63 microns in the upper atmosphere and its contribution to the heat conduction equation are analyzed. As the infrared emission is an important cooling mechanism, the physical processes involved are described. A radiation transfer equation is solved and the results indicate that the optically thin approximation used is no longer valid below 150 km. ESRO

N70-42416*# Southwest Center for Advanced Studies, Dallas, Tex. Geosciences Div.
TECTONIC EFFECTS OF SEA-FLOOR SPREADING ON THE ARABIAN SHIELD
Peter J. Burek [1970] 6 p

(Grants NGL-44-004-001; NSF GA-1601; NSF GA-590; (NASA-CR-110788 BU-183/1+2) Avail: NTIS CSCL 08J

The separation of the Arabian Shield from the African continent is investigated as an example of continental drift and for the tectonic effects of ocean floor spreading. Data show that the linear magnetic anomalies over the Gulf of Aden and the Red Sea rift are consistent with the hypothesis of sea floor spreading. Recent oceanographic data also indicate that the Gulf of Aden and the Red Sea represent rift troughs in an early stage of development rather than simple graben structures. Comparison between the Gulf of Aden and Red Sea troughs shows that the Aden rift is wider and in a more advanced stage of development. Volcanism, epirogeny, and orogeny are considered in the tectonic history of the Gulf of Aden and the Red Sea. R.B.

N70-42449# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Feb. 1970 [OBSERVATIONS GEOPHYSIQUES Bulletin Mensuel, Fevrier 1970]
1970 39 p In FRENCH and DUTCH
Avail: NTIS

Geophysical data observed at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during February 1970 are presented. ESRO

N70-42460*# Scientific Translation Service, Santa Barbara, Calif.
ANISOTROPISM OF P-WAVE IN DUNITE [DUNITE NO P-HA IHOSEI]
J. Kasahara et al Washington NASA Oct. 1970 11 p refs Transl. into ENGLISH from Jishin (Tokyo), v. 21, 1968 p 222–228
(Contract NASw-2035)
(NASA-TT-F-13320) Avail: NTIS CSCL 08G

The compressional wave velocity and the preferred orientation of olivine of Hidaka Horoman dunite (sample name HD 20 A) were measured. Fabrics of compressional wave velocity of the dunite and preferred orientation of olivine in the dunite are shown. These fabrics are closely related to each other. The olivine crystallographic 'a' axis is concentrated about the tectonic X axis. The maximum compressional velocity is 8.8 km/s and the minimum one is 7.9 km/s. Author

N70-42464# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Apr. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE Bulletin Mensuel, Avril 1970]
1970 31 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for April 1970. ESRO

N70-42496# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Jan. 1970 [OBSERVATIONS GEOPHYSIQUES Bulletin Mensuel, Janvier 1970]
1970 38 p In FRENCH and DUTCH
Avail: NTIS

Geophysical data observed at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during January 1970 are given. ESRO

N70-42497# Bonn Univ. (West Germany). Physikalisches Inst.
MEASUREMENTS OF THE NUMBER DENSITIES OF ATOMIC AND MOLECULAR OXYGEN IN THE LOWER THERMOSPHERE [MESSUNGEN DER TEILCHENDICHTEN VON ATOMAREM UND MOLEKULAREM SAUERSTOFF IN DER UNTEREN THERMOSPHAERE]
K. Bruchhausen and U. von Zahn Jun. 1970 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-29) Avail: NTIS; ZLDI Munich: 14,50 DM

Two ESRO rocket payloads were launched from Sardinia (Italy) in October 1967 each carrying two mass spectrometers. From 130 to 205 km altitude, the molecular oxygen number densities agreed well with published results, but they were lower than the CIRA 1965 values by a factor of two to three. Similar data for atomic oxygen were higher than previously announced but agreed with EUV absorption measurements and were about 20 per cent to 30 per cent higher than CIRA 1965 predictions. Author (ESRO)

N70-42524# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Feb. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE Bulletin Mensuel, Fevrier 1970]
1970 30 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for February 1970. ESRO

N70-42528# Northern Research and Engineering Corp., Cambridge, Mass.
IGNITION AND SUSTAINING OF COMBUSTION BY ENERGY ADDITION IN TURBULENT SUPERSONIC FLOW Final Scientific Report
Kenneth N. C. Bray and Ronald S. Fletcher Jul. 1970 50 p refs
(Contract F44620-68-C-0058)
(AD-710283; NREC-1132-1; AFOSR-70-1959TR) Avail: NTIS CSCL 21/2

The objective of the study is to obtain data on turbulent, supersonic combustion which will facilitate development of ignition systems for use in scramjet engines under conditions when combustion cannot occur spontaneously. To this end a simple analytical model of a reacting, turbulent flow is presented, based upon the a priori assumption that combustion and turbulent mixing can be uncoupled. Predictions from this model are compared with some new experimental data on the ignition of ethylene in air. Both premixed and unpremixed situations are included. Tests of the validity of the mixing model are made for the nonreacting case by comparing predicted and measured velocity profiles in a duct; a satisfactory agreement is obtained. The predicted ignition requirements also match the measured values in most cases, with mixing- and reaction-rate data taken from the literature. Until uncertainties in these mixing- and reaction-rate expressions can be substantially reduced, the use of more subtle coupling models in the determination of ignition requirements does not appear to be justified. A much simpler model is also presented and used to derive a useful criterion for the prediction of the ignition boundaries in premixed fuel-air flows. Author (TAB)

N70-42531 National Lending Library for Science and Technology, Boston Spa (England).
SOLIFLUCTION RELIEF FORMS IN THE NORTH EAST OF THE USSR [SOLIFLUKTSIONNYE FORMY RELIEFS NA SEVERO-VOSTOKE SSSR]
L. A. Zhigarev et al Jul. 1970 28 p refs Transl. into ENGLISH from Tr. Inst. Merzlotoved., Akad. Nauk SSSR (Moscow), no. 16, 1960 p 46–59
(NLL-RTS-5746) Avail: Natl. Lending Library, Boston Spa, Engl.: 54s; 9 NLL photocopy coupons

Solifluction relief forms are discussed for Northeast U.S.S.R. The relief forms studied are characterized as frost, terraces, ridges, or mantles. One of the important factors in the widespread

solifluction is the permafrost, which results in the fluid state of the soils, due to the impermeability of the frozen zone to water during the surface thawing seasons. The structure of the loose deposits along the slopes is analyzed. It is concluded that a basic factor in the modelling of the relief is the region investigated. F.O.S.

N70-42603# Kiruna Geophysical Observatory (Sweden).
A STUDY OF DIURNAL AND SEASONAL VARIATIONS IN THE OCCURRENCE OF IONOSPHERIC ABSORPTION AND 5577 A AURORAL EMISSION AT SUBAURORAL LATITUDES
Ludwik Liszka Paris ESRO Sep. 1969 30 p refs
(ESRO-SN-105) Avail: NTIS

A study of the frequencies of occurrence of different levels of the ionospheric absorption at 27.6 MHz, observed at Kiruna, Sweden, during the years from 1959 to 1968 is described. The cumulative distribution of the occurrence of different levels of absorption varies throughout the day, having the gentlest slope during the morning. Studies of the diurnal and seasonal variations of the occurrence of 1 and 3 dB levels during solar minimum years showed that the smallest frequency of occurrence of absorption events was observed during winters. The frequency of occurrence of absorption events was also compared with the simultaneous occurrence of the 5577 A emission. Author (ESRO)

N70-42620# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
SOLAR UV DATA FROM A BALLOON BORNE SPECTROPHOTOPOLARIMETER Final Report, 30 Sep. 1965 - 30 Jun. 1970
Ellis B. Hodgdon Apr. 1970 84 p refs
(Contract AF 19(628)-5707)
(AD-709893; GIT-B-216-F; AFCRL-70-0248) Avail: NTIS CSCL 3/2

Considerable data are obtained from an UV spectrophotopolarimeter which must be reduced in order to obtain the intensity and other components of the Stokes vector of the incident skylight. The telemetered data are obtained in analog form, digitized and then processed through a digital computer to obtain the Stokes vector. The purpose of this report is to describe this flow of digital information from both the raw telemetry data and the calibration data to the final results and to present several spectra obtained at various altitudes above 80,000 feet and sun aspect angles. Considerable previous work has been done along these lines which do produce feasible results, but the procedure described here includes refinements in these procedures as well as an estimation of the amount of error in each calculation, and the result is a single computer program that produces a time edit and time merge of the digitized data and the subsequent calibration or data reduction. The procedure has been tested with both generated and actual data and the spectra obtained indicates that the program and method of data reduction work satisfactorily. Author (TAB)

N70-42626*# Texas A&M Univ., College Station. Remote Sensing Center.
REMOTE SENSING OF CROP WATER DEFICITS AND ITS POTENTIAL APPLICATIONS: AN ANNOTATED BIBLIOGRAPHY
W. P. David Sep. 1969 52 p refs
(Grant NGL-44-001-001)
(NASA-CR-110830; RSC-06) Avail: NTIS CSCL 08H

The feasibility of using remote sensors in detecting water deficits in plants is examined. Techniques for the remote sensing of crop water deficits are presented for planning efficient water resources management and deciding on the use and distribution of diverted irrigation water. Background information on the significance of crop water deficits to crop production, on the development and symptoms of crop water deficits, and on the energy environment of plants is presented. The characteristics of plants that influence both reflectance and emittance of electromagnetic or radiant energy are also included. Author

N70-42632# Institute for Telecommunication Sciences, Boulder, Colo. Research Labs.
A SURVEY AND ANALYSIS OF NORMAL IONOSPHERIC ABSORPTION MEASUREMENTS OBTAINED FROM RADIO PULSE REFLECTIONS
Larry D. Schultz and Roger M. Gallet Sep. 1970 39 p refs
/ts ESSA Profess. Paper No. 4
Avail: SOD $0.45

An analysis of published midday absorption data obtained by the reflection method of vertical incidence sounding quantitatively establishes the existence of an equatorial absorption anomaly. This anomaly is the abnormally large variation of the amplitude of the seasonal variation observed at equatorial latitudes. It is suggested that certain D region dynamical processes cause this anomaly. In addition, the analysis disclosed the unexpected existance of a significant latitudinal variation of absorption not due to the cos sup n X variation; the order of magnitude of this latitudinal variation is of the same order as the variation of absorption due to the sunspot cycle. This latitudinal variation, together with the latitudinal variation of the E layer critical frequency, indicates that the electron producing mechanisms for the lower ionosphere vary systematically with latitude and solar activity. For middle latitudes, the analysis reconfirmed results obtained previously by other authors. The total variation of lower ionosphere absorption is separated into the four categories: (1) seasonal variation with latitudinal effects, (2) latitudinal variation, (3) solar cycle variation, and (4) winter anomaly effects. Empirically derived formulas are given which permit the calculation of each of these four variations and also the calculation of the total lower ionosphere absorption losses of HF radio waves propagating via the ionosphere both at vertical and at oblique incidence. Author

N70-42640# Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.
INVESTIGATION OF THE ABSORPTION OF INFRARED RADIATION BY ATMOSPHERIC GASES Semiannual Technical Report
Darrell E. Burch, David A. Gryvnak, and John D. Pembrook Jun. 1970 52 p refs
(Contract F19628-69-C-0263; ARPA Order 1366)
(AD-709894; U-4829; AFCRL-70-0373) Avail: NTIS CSCL 7/4

From spectral transmittance curves of very large samples of CO2 we have determined coefficients for intrinsic absorption and pressure-induced absorption from approximately 1130/cm to 1835/cm. Most of the pressure-induced absorption arises from the forbidden v1 and 2v2 bands of the O16C12O18 molecule. Curves of the absorption coefficients for samples of CO2 pressurized to approximately 10 atm, or more, with He are presented throughout most of the region from 1885/cm to 2132/cm. These curves and a table of the integrated absorption coefficient are adequate to determine the strengths of most of the bands of significance in this region. Spectral transmittance curves of CO2 absorption between approximately 2065/cm and 2100/cm are presented for a variety of samples. Curves of the pressure-induced absorption by N2 are presented for the 2400-2650/cm region. Author (TAB)

N70-42642# Aerospace Corp., El Segundo, Calif. Lab. Operations.
COMPRESSIBLE COROTATION OF A MODEL MAGNETOSPHERE
Michael Schulz 30 Jul. 1970 15 p refs
(Contract F04701-70-C-0059)
(AD-710603; TR-0059(6260-20)-5; SAMSO-TR-70-276) Avail: NTIS CSCL 4/1

Calculated for a simplified model of the distorted magnetosphere, the electric field induced by the earths rotation exhibits an azimuthal asymetry somewhat similar to that of the

magnetic field. Analytical tracing of the resultant field-line motion in the equatorial plane indicates that the magnetosphere does not rotate rigidly with the earth, but that the time (one day) required for a complete rotation is the same for all field lines. Author (TAB)

N70-42645# Weather Wing (4th), Ent AFB, Colo.
IONOSPHERIC ELECTRON DENSITY PROFILE MODEL
Thomas D. Damon and Franklin R. Hartranft Jul. 1970 41 p refs
(AD-709888; WW-TM-70-3) Avail: NTIS CSCL 4/1

The paper describes a project undertaken by 4th Weather Wing to produce a realistic electron density profile based upon parameters which can be forecast with reasonable accuracy. The ionospheric electron density profile model presented in this paper consists of the sum of three Chapman layers (E, F1, F2). Electron densities in the topside ionosphere are controlled by complex motions rather than a production-loss balance and cannot be successfully described strictly by a Chapman layer. After some experimentation a best fit was obtained by simply using the Chapman equation for the topside ionosphere, but computing the electron densities by using a variable scale height throughout the region. The program described in this report has been used routinely for eight months to predict profiles for radar refraction. This report should be considered interim as improvements in accuracy are sure to be required as the model is evaluated for different purposes. Author (TAB)

N70-42677# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ON ESTIMATING EXPLOSIVE SOURCE PARAMETERS AT TELESEISMIC DISTANCES
John R. Filson 8 Jul. 1970 33 p refs
(Contract AF 19(628)-5167)
(AD-709767; TN-1970-9; ESD-TR-70-196) Avail: NTIS CSCL 17/10

A study has been made of the short period spectra of five presumed explosions recorded at five arrays. An attempt has been made to relate contrasts in spectra of different events recorded at the same site, to source size, and contrasts observed at different arrays for a given event, to the earths attenuative properties. Haskells model for the explosion spectrum was fitted to each event individually after corrections for instrument response and various exponential attenuations. At a single array, that attenuation which allowed the fitted parameters to vary as dictated by the model was chosen as the correct one. With the attenuation estimated to each array, the spectra observed at all the arrays for a single event are fitted to a source model simultaneously. In most cases the individual and simultaneous fitting schemes yield reasonable values for the source parameters. Haskells model and the estimated attenuation parameter for a central Asia to LASA path apparently explains a trend in short period spectral ratio measurements as a function of magnitude. Author (TAB)

N70-42682*# Texas A&M Univ., College Station. Remote Sensing Center.
RADAR SCATTEROMETER DATA ANALYSIS
John W. Rouse, Jr. May 1969 24 p refs Sponsored in part by Raytheon Co.
(Grant NGL-44-001-001)
(NASA-CR-110831; RSC-01) Avail: NTIS CSCL 08B

Mission 73 of the NASA/MSC earth resources aircraft program was flown over selected sites in Southern California to satisfy objectives within the disciplines of geology, geography, forestry, and hydrology. Included among the several remote sensors employed in the study was a Ryan Redop 2.25 cm wavelength radar scatterometer. Previous experiments with this sensor has confirmed its applicability to determination of sea state and differentiation of Arctic ice type. Earlier NASA/MSC Missions have employed the Ryan system to record backscatter energy from terrain, however, these data have not been analyzed. The described research constitutes an engineering experiment to determine the geoscience application areas of this sensor by evaluating its performance over specific, documented regions. Author

N70-42701*# Michigan Univ., Ann Arbor. Electron Physics Lab.
AN INVESTIGATION OF NONLINEAR INTERACTION PHENOMENA IN THE IONOSPHERE Final Report, 1 Jun. 1964 – 1 Oct. 1969
R. Hu and J. E. Rowe Nov. 1969 93 p refs
(Grant NGR-23-005-062)
(NASA-CR-110838) Avail: NTIS CSCL 20N

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1. HYDRODYNAMIC ANALYSIS OF NOISE IN A FINITE TEMPERATURE ELECTRON BEAM A. C. Hsieh 8 p refs (See N70-42702 24-09)

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6. WHISTLER MODE PROPAGATION IN THE IONOSPHERE IN THE PRESENCE OF A LONGITUDINAL STATIC ELECTRIC FIELD H. C. Hsieh 11 p refs (See N70-42707 24-07)

7. PROPAGATION OF CIRCULARLY POLARIZED ELECTROMAGNETIC WAVES IN A FINITE TEMPERATURE ELECTROMAGNETOPLASMA H. C. Hsieh 9 p refs (See N70-42708 24-07)

8. FOCUSING OF A RELATIVISTIC ELECTRON FLOW H. C. Hsieh and J. E. Rowe 8 p refs (See N70-42709 24-07)

N70-42703*# Michigan Univ., Ann Arbor. Electron Physics Lab.
A THEORY OF IONOSPHERIC THERMAL RADIATION
H. C. Hsieh *In its* An Invest. of Nonlinear Interaction Phenomena in the Ionosphere Nov. 1969 13 p refs Repr. from J. Atmos. Terrest. Phys. (Northern Ireland), v. 28, 1966 p 769–781 refs (See N70-42701 24-13)
(Grant NsG-696)
Avail: NTIS CSCL 20N

The ionosphere is considered as a dissipative medium in which the random thermal motions of the charged particles act as a source of thermal radiation. Attention was focused on the electrons colliding with ions and neutral particles in the ionosphere. A method of analysis was developed with the aid of the Maxwell and Langevin equations based on a linear, macroscopic, fluctuating electromagnetic field theory. The spectral density of the random-current source function is derived in terms of the conductivity tensor of the ionosphere. The ionosphere is divided into a large number of incremental volume elements, each containing an ionized medium which represents an anistropic elementary radiating system, characterized by the spectral density of the source function. The radiation characteristic of the radiating system observed at a point located outside of the source region is obtained with the aid of the potential functions which relate the thermal electromagnetic fields at the observation point to their source function. Based on the superposition principle, general expressions were derived for the thermal noise power generated per unit volume, per unit bandwidth, from any given source region of the ionosphere, and for the available thermal noise per unit bandwidth at a receiving antenna. Author

N70-42704*# Michigan Univ., Ann Arbor. Electron Physics Lab.
CHARACTERISTICS OF IONOSPHERIC THERMAL RADIATION

H. C. Hsieh *In its* An Invest. of Nonlinear Interaction Phenomena in the Ionosphere Nov. 1969 6 p refs Repr. from J. Atmos. Terrest. Phys. (Northern Ireland), v. 28, 1966 p 783–788 refs
(See N70-42701 24-13)
(Grant NsG-696)
Avail: NTIS CSCL 20N

A theoretical observation of the characteristics of ionospheric thermal radiation is made using a linear theory based on a macroscopic concept with the aid of fluctuating electromagnetic field theory. The thermal noise power generated in the ionosphere per unit volume, per unit frequency bandwidth, and the available thermal noise power at receiving antenna per unit frequency bandwidth are calculated. The spectral distributions of ionospheric thermal radiation are obtained and discussed in detail. A study of the calculated power level of the thermal noise generated in the ionosphere shows that it is exceedingly low and decreases rather rapidly with an increase of frequency f. The study reveals that the available noise power at a receiving antenna depends upon the geographical location of the antenna in general and that the power level is higher in the equatorial zone than in the polar cap zone. For a noise signal frequency of less than 10 to the 8th power c/s, the power level increases monotonically with an increase of polar angle theta from theta = 0 and reaches its maximum value at theta = 90 deg, where it is at least a hundred times greater than at theta = 0. For a noise signal with a frequency of 10 to the 9th power c/s, the available noise power has its maximum at theta congruent to 50 deg, where the power level is comparable to that of a noise signal with a frequency of 10 to the 6th power c/s. For a noise signal of a frequency above 5 × 10 to the 9th power c/s, the angular dependence disappears. Author

N70-42743*# Texas A&M Univ., College Station. Remote Sensing Center.
HERIAL 8-14 MICRON IMAGERY APPLIED TO MAPPING THERMAL EFFECT MIXING BOUNDARIES
Norman Gray Foster (M.S. Thesis) Aug. 1970 140 p refs
(Grant NGL-44-001-001)
(NASA-CR-110870; RSC-15) Avail: NTIS CSCL 13B

The investigation was limited to determining water temperatures, calculating a steady-state energy balance of a fossil-fueled power plant effluent both from airborne imagery and from ground observations, and comparing the two calculations. The results enhance the practical applications of remote imagery to aquatic ecology studies. Airborne 8-14 micron wavelength imagery was obtained over discrete locations along heated water effluent canals, coincident with subsurface water temperature measurements at the same locations. Water temperature and calculated heat exchange between the canal water and the atmosphere were compared, using ground measurements and photointerpreted measurements from the airborne data. Results show that gross photointerpretation techniques can delineate water temperatures within five percent. Author

N70-42768# Transportation Systems Center, Cambridge, Mass.
EARTH SURVEY BIBLIOGRAPHY: A KWIC INDEX OF REMOTE SENSING INFORMATION
William I. Thompson, III Sep. 1970 269 p refs
Avail: Issuing Activity

A bibliography of citations pertaining to the Earth Resources Program is presented. The scope ranges from detailed discussions on the politics of earth survey operations to selection of film used for aerial surveys. The bibliography is intended as a source document leading quickly to specific information and sources of additional information. Author

N70-42772*# Scientific Translation Service, Santa Barbara, Calif.
PLANE AND SPHERICAL WAVE VELOCITIES AND ENERGY FLOW IN ANISOTROPIC MEDIA
J. Kasahara et al Washington NASA Oct. 1970 16 p refs Transl. into ENGLISH from Jishin (Tokyo), v. 21, 1968 p 282–292
(Contract NASw-2035)
(NASA-TT-F-13323) Avail: NTIS CSCL 08K

The concepts of the wave surface related to spherical waves, and the velocity surface, related to plane waves in anisotropic media, are introduced. The wave surface and elastic constants of the Sanbagawa green schist (No. 904) were measured experimentally. The wave surfaces obtained from experiments and by calculation were consistent. The direction of energy flow in the green schist was also measured. This direction was closely correlated to the wave surface. Author

N70-42774*# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
AIR POLLUTION FROM FUTURE GIANT JETPORTS
James A. Fay May 1970 14 p refs *Its* Fluid Mech. Lab. Publ. No. 70-6
(Grant NGR-22-009-378)
(NASA-CR-110887) Avail: NTIS CSCL 13B

A meteorological model is presented to calculate the average concentration of a pollutant, emitted at a mass rate per unit of vertical ascent and descent during a landing and takeoff cycle, if the frequency of such cycles and wind speed is given. Based on this simple meteorological model, calculations of the ambient levels of nitric oxide and particulates to be expected downwind of a giant jetport show them to be about equal to those in present urban environments. These calculations are based on measured emission rates from jet engines and estimates of aircraft performance and traffic for future jetports. Author

N70-42775# Naval Oceanographic Office, Washington, D.C.
SEDIMENTATION IN NORTHERN AND CENTRAL PARTS OF THE INDIAN OCEAN [OSADKOOBRAZOVANIYE V SERVERNOY I TSENTRALNOY CHASTYAKH INDIISKOGO OKEANA]
P. L. Bezrukov 1970 20 p refs Transl. into ENGLISH from Mezhdunar. Geol. Kongr., 22 (USSR), 1964 p 41–51
(AD-709322; NOO-Trans-265) Avail: NTIS CSCL 8/10

In 1959-62 during three voyages of the r/v Vityaz 270 grab samples and 256 cores of sediments, from 1 to 15m long were collected in the central and northern part of the Indian Ocean including the Arabian Sea, the Bay of Bengal and the Andaman Sea. It is possible to distinguish the following sediments by their genetic composition in the northern part of the Indian Ocean: I. Terrigenous; II. Volcanogenous; III. Organogenous; (1) calcareous-foraminiferal ooze, pteropod ooze, coral sediments; (2) siliceous-radiolarian ooze, diatoms ooze; IV. Polygenous (red and grey clays); V. Chemogenous (manganese nodules). More fractional types of sediments are present in each group by their granulometric composition. Numerous outcrops of hard crops mainly basalts were found on the ocean bottom. The serpentinites were found on the surface of the Arabian-Indian Ridge. Author (TAB)

N70-42783# Oak Ridge National Lab., Tenn.
SEISMIC HISTORY AND SEISMICITY OF THE SOUTHEASTERN REGION OF THE UNITED STATES
W. C. McClain and O. H. Myers Jun. 1970 46 p refs
(Contract W-7405-eng-26)
(ORNL-4582) Avail: NTIS

A complete seismic history of the southeast region of the United States was compiled for possible use in the evaluation of the seismic hazard at proposed nuclear installation sites. Examination of the seismicity of the area, based on this history, indicated that the highest seismic risk existed in two small areas around New Madrid, Missouri, and Charleston, South Carolina, but that the general level of seismicity in the southeast region was about two orders of magnitude less than in California. Various types of special seismic histories for smaller areas of the southeast region are available for evaluations of particular sites. Author (NSA)

N70-42811*# Texas A&M Univ., College Station. Remote Sensing Center.
REMOTE SENSING IN AGRICULTURE: AGRONOMIC SCIENCES: A SELECTED BIBLIOGRAPHY WITH ABSTRACTS
R. H. Griffin, II, comp. [1969] 156 p refs
(Grant NGL-44-001-001)
(NASA-CR-110867; RSC-08) Avail: NTIS CSCL 08D

The objective of the bibliography is to bring together in one document abstracts of current reports on remote sensing in agriculture, with special emphasis placed on the area of soils and agronomic crops. Included are articles that range from suggested or possible agricultural uses of remote sensing to articles that deal primarily with the theory of measurement by a particular sensor. This search covers primarily the literature from 1967 to the present. Author

N70-42813*# Howard Univ., Washington, D.C.
LOW ENERGY ACTIVATION ANALYSIS FOR GEOCHEMICAL EXPLORATION
George A. Ferguson 1 Aug. 1970 19 p refs
(Grant NGR-09-011-022)
(NASA-CR-110888) Avail: NTIS CSCL 03B

Research is reported in a program to obtain pulse height spectra using radioisotopic calibration sources and monochromatic radiation produced by a bent crystal spectrometer. Descriptions are given for the methodology and instrumentation employed in the research. The experimental results are detailed and their significance analyzed. D.L.G.

N70-42930# Nevada Univ., Reno. Mackay School of Mines.
SEISMICITY, MECHANICS OF FAULTING AND CRUSTAL STRUCTURE WITHIN THE BASIN AND RANGE AND ADJOINING PROVINCES Final Report, 14 Apr. 1969–14 Apr. 1970
Gary W. Boucher and Alan S. Ryall 18 Jun. 1970 23 p refs
(Grant AF-AFOSR-1820-69; ARPA Order 292)
(AD-710287; AFOSR-70-2085TR) Avail: NTIS CSCL 17/10

The University of Nevadas 3 component quartz-rod strainmeter installation at Round Mountain, Nevada has recorded a number of underground nuclear explosions at the Nevada Test Site, beginning with the megation-sized JORUM event September 16, 1969. That explosion, and the larger HANDLEY event on March 26, 1970 both produced static strain offsets of a few parts in 10 to the 9th power at Round Mountain. These offsets did not decay within the first few hours after the explosions. In both cases the strain offsets were in the sense of ground extension radial to the shot point, which is inconsistent with the assumption of a pure compressive source of strain. Author (TAB)

N70-42935*# Illinois Univ., Urbana. Aeronomy Lab.
FORTRAN PROGRAMS FOR CALCULATING LOWER IONOSPHERE ELECTRON DENSITIES AND COLLISION FREQUENCIES FROM ROCKET DATA
E. A. Mechtly, P. E. Monro, N. Golshan, and R. S. Sastry 1 Jul. 1970 62 p refs *Its* Aeronomy Rept. No. 37
(Grant NGR-14-005-013)
(NASA-CR-110899; UILU-ENG-70-260) Avail: NTIS CSCL 04A

A record and discussion are given of computer programs used for calculating D and E region electron densities and collision frequencies from Faraday rotation, differential absorption, and standing wave data obtained from Nike Apache rocket radio propagation experiments. All the programs are written in FORTRAN 4 and are compatable with the IBM 360 system. Author

N70-43058# Rhode Island Univ., Kingston. Narragansett Marine Lab.
TRANSPORT AND VELOCITY OF THE GULF STREAM AT CAPE HATTERAS
Philip L. Richardson and John A. Knauss Mar. 1970 121 p refs *Its* Ref. No. 70-1
(Contract Nonr-396(08))
(AD-710427; TR-31) Avail: NTIS CSCL 8/3

Despite numerous measurements of the transport of the Gulf Stream the true value of its transport remains in question. The uncertainty is due to the many assumptions and approximations employed in the geostrophic calculation of transport. In order to make a reliable determination of total transport Dr. John A. Knauss led in July 1967 a research cruise to the Gulf Stream at Cape Hatteras and made a series of direct transport and hydrographic measurements. The work presented here is an analysis of the information obtained on this cruise in order to determine the total transport of the Gulf Stream and to determine the velocity field of the subsurface currents at Cape Hatteras. Measurements were made with transport floats, free falling instrument packages similar to those developed by Richardson and Schmitz for direct transport measurements in the Straits of Florida. Author (TAB)

N70-43062# Wyle Labs., Inc., Huntsville, Ala.
ABSORPTION OF SOUND IN AIR Final Report, 23 Jun. 1969–22 Jun. 1970
L. B. Evans and L. C. Sutherland Jul. 1970 80 p refs
(Contract DAHC04-69-C-0088)
(AD-710291; WR-70-14; AROD-8725-2-E) Avail: NTIS CSCL 4/1

Experimental measurements of the absorption of sound in still air exhibit a distinct deviation from the theoretical predictions based on known classical and molecular relaxation absorption losses. Investigation of published laboratory data has verified that Knesers theory for molecular relaxation accurately describes the absorption loss near and above the relaxation frequency. At frequencies less than about 0.1 of the relaxation frequency, a different mechanism becomes predominant and results in an absorption loss component which varies directly with the fequency and is essentially independent of humidity. The objective of the effort in this contract was to carry out a detailed experimental and analytical investigation of this anomaly to allow numerical calculations to be made of air absorption for a variety of atmospheric conditions in still air. Author (TAB)

N70-43064*# Illinois Univ., Urbana. Aeronomy Lab.
D-REGION ION CHEMISTRY
S. M. Radicella and D. W. Stowe 15 Jul. 1970 147 p refs *Its* Aeronomy Rept. No. 38
(Grant NGR-14-005-013)
(NASA-CR-110896; UILU-ENG-70-261) Avail: NTIS CSCL 04A

The neutral composition of the mesosphere is reviewed with emphasis on nitrogen oxides and oxygen allotropes. Ionization sources in the D region are studied including the effects of recent experimental results. The negative ion chemistry is discussed including the calculation of an effective attachment factor, beta sub eff'. On the basis of the experimental beta sub eff', a new fast binary attachment process is considered. Relevant experimental data are tabulated, and the diurnal variation of atomic oxygen and ozone concentrations are presented, based on recent values for the relevant rate coefficients. Author

N70-43067# Military Research and Development Center, Bangkok (Thailand).
IONOSPHERIC DATA REPORT Monthly Data Report, Feb. 1970
Feb. 1970 38 p
(AD-710432; MRDC-70-002) Avail: NTIS CSCL 20/14

Ionospheric observations are being carried out at the Operations Room, Vertical-Incident Sounder Site, located at the Applied Scientific Research Corporation of Thailand, Bangkok, Thailand. Data are being taken with a modified model C-2 Vertical-Incident Sounder. This information is supplied to the Environmental Science Services Administration at Boulder, Colorado, U.S.A., for inclusion in the data base which supports their production of the World Wide Radio Propagation Charts. Author (TAB)

N70-43086# Institut d'Aeronomie Spatiale de Belgique, Brussels.
ABSORPTION CROSS SECTIONS OF THE SCHUMANN-RUNGE BANDS OF MOLECULAR OXYGEN
M. Ackerman, F. Biaume, and G. Kockarts 1970 30 p refs Submitted for publication *Its* Aeronomica Acta No. A-73-1970
Avail: NTIS

The absorption bands of the Schumann-Runge system of molecular oxygen, which overlap the Herzberg continuum, were studied in order to improve aeronomic calculations in the mesosphere and stratosphere. After a high resolution analysis of the rotational structure from the (0-0) band at 2050 A to the dissociation limit at 1750 A, absorption cross sections for various rotational lines were measured from 2011.63 A to 1763.66 A. The absorption cross sections were obtained with 0.5 per cm resolution taking into account the rotational line shape due to pre-dissociation, Franck-Condon factors, and electronic absorption oscillator strengths. Author (ESRO)

N70-43097# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Div. of Radiophysics.
CLOUD-SEEDING EXPERIMENT, TASMANIA Report of Operations, 1967 – 1968
E. J. Smith and E. E. Adderley Dec. 1969 100 p refs
(RPR-169) Avail: NTIS

A cloud seeding experiment was conducted to determine the amount by which seeding clouds with silver iodide smoke released from an aircraft can increase precipitation in a hydroelectric catchment area, the circumstances in which the increases can be obtained, and the duration of the effects. The seeding operation carried out in alternate years, is described. Author

N70-43116# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR SEPTEMBER 1968 FROM WOOMERA, SOUTH AUSTRALIA
Apr. 1970 30 p refs
(SAD-1968/9(W)) Avail: NTIS

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for September 1968. Author

N70-43137# Dayton Univ. Research Inst., Ohio.
A THREE STATION METHOD TO ACQUIRE SMOKE TRAIL POSITION Final Report, Jan. 1967 – Dec. 1969
Robert P. Boehmer Apr. 1970 79 p refs
(Contract F19628-70-C-0045)
(AD-709895; UDRI-TR-70-19; AFCRL-70-0262) Avail: NTIS CSCL 4/1

The report describes a three camera solution for position data. The topics covered include a method of reducing the data from the film, a method of pairing the data from the three cameras into possible solutions, the calculation of the optimum solution point using the paired data, and the errors of closure in the optimum solution point. These errors of closure are used both to determine the quality of the solution and to estimate the error in any calculated wind. Author (TAB)

N70-43144# Weapons Research Establishment, Adelaide (Australia).
A SEASONAL MODEL FOR THE ZONAL WIND IN THE ALTITUDE RANGE 35 TO 75 km AT WOOMERA 31 DEG S
R. J. Curnow Jun. 1970 27 p refs
(WRE-TN-HSA-172) Avail: NTIS

A seasonal model for the zonal wind in the height range 35 to 75 km is presented. This is based on data from between thirty and fifty falling sphere and parachute experiments. Author

N70-43148# Department of Scientific and Industrial Research, Christchurch (New Zealand). Geophysics Div.
SEISMOLOGICAL OBSERVATORY, WELLINGTON, 1970
1970 22 p *Its* Inform. Ser. No. 73
(S-164) Avail: NTIS

The Seismological Observatory, Wellington, is a branch of the Geophysics Division of the New Zealand Department of Scientific and Industrial Research. Its responsibilities include the scientific study of the earthquakes of New Zealand and its neighbouring territories, and the supply of information about the seismicity of this region both to the general public and to those with special interests in the subject, such as engineers, architects, and insurance assessors. In addition to its regional studies, the Observatory publishes readings of overseas earthquakes, supplies data to international agencies, and conducts research into fundamental problems of earthquake occurrence and the structure of the Earth. It also provides the New Zealand Time Service, maintaining accurate clocks and providing radio signals for shipping, scientific, and civil purposes. Author

N70-43150 National Lending Library for Science and Technology, Boston Spa (England).
ON THE PROBLEM OF THE ERADICATION OF ARCTIC ICE
Ju. P. Doronin 21 Oct. 1969 18 p refs Transl. into ENGLISH from Probl. Arkt., Antarkt. Vyp. (Leningrad), v. 28, 1968 p 21–28
(NLL-M-7823-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The feasibility and the climatic changes which might occur after eradication of the Arctic ice cover are discussed. A method is derived to calculate the temperature of the active layer of the ocean, taking into account its structure. The various proposals and methods for eliminating the ice cover are reviewed, and the studies show that the possibility of liquidating the relatively fresh layer and increasing warm advection of the Arctic Ocean are requisites in developing such a plan. R.B.

N70-43163# Environmental Research Corp., Alexandria, Va.
EFFECTS OF LOCAL GEOLOGY ON THE AMPLITUDES OF SEISMIC WAVES, VOLUME 2
J. R. Murphy, N. L. Weaver, and G. B. Lamers Jun. 1970 149 p Supported by AEC
(NVO-1163-205-Vol-2) Avail: NTIS

An experimental seismic wave amplification factor is defined, and a large number of examples of amplifications observed at the Nevada test site for a wide range of geologic environments and ground motion intensities are presented. NSA

N70-43168# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A TECHNIQUE FOR USING THE DISTURBING-BEFORE-WANTED INTERACTION EXPERIMENT TO OBTAIN THE EXCESS ELECTRON ENERGY LOSS FACTOR
W. A. Kissick 10 Aug. 1970 72 p refs
(Contract Nonr-656(35); Grant NSF GA-1456)
(AD-710426; SR-361) Avail: NTIS CSCL 4/1

The development of the electron energy balance equation, as it is used in D-region interaction studies, is examined. It is proposed to experimentally find the excess electron energy loss factor, G, that appears in this equation. G represents the fraction of excess energy (above ambient) that an electron loses per collision with a neutral particle. An experiment in which the disturbing pulse is transmitted before the wanted pulse is described and the necessary theory derived. The interaction equations are then programmed on a digital computer to examine the effects of ionospheric parameters. It is shown that the Disturbing-Before-Wanted experiment is sensitive to G. A graphical

technique for the reduction of experimental data is developed, and some preliminary results are shown in the form of the seasonal variation of G. Author (TAB)

N70-43173# Dominion Observatory, Ottawa (Ontario).
RECORD OF OBSERVATIONS AT VICTORIA MAGNETIC OBSERVATORY, 1968
D. R. Auld and I. W. Fetterley 1970 54 p refs *Its* Publ. Vol. 39, No. 9
Avail: NTIS

A new absolute instrument for the determination of D and I was installed in March of 1968. The instrument is a GSI precise magnetometer, following the rotating coil design. Measurements of D and I were carried out for a six-month overlap period with both the new Sokkisha instrument and the previously used three-component saturable core magnetometer. The Sokkisha magnetometer replaced the fluxgate instrument as the primary standard for D and I. Author

N70-43175# Midwest Research Inst., Kansas City, Mo.
A DIRECT MASS SPECTROMETRIC STUDY OF THE FORMATION AND REACTIONS OF WATERCLUSTER IONS Final Report, 15 Mar. 1968 – 15 Mar. 1970
Thomas A. Milne, Jacob E. Beachey, and Frank T. Greene 9 Jun. 1970 36 p refs Sponsored in part by DASA
(Contract F19628-68-C-0276)
(AD-709229; AFCRL-70-0341) Avail: NTIS CSCL 4/1

In an effort to establish the reasonableness of one postulate as to the origin of water-cluster ions in the D-region of the atmosphere, the authors have investigated the direct electron-impact ionization properties of small water clusters. Water clusters were generated in free-jet expansions of moist Argon, yielding an electron-impact mass-spectrum consisting of the ion series H(+).(H2O)n. Electron impact appearance potential measurements are described, yielding appearance potentials substantially higher than predicted from thermochemical cycles involving ion dissociation energies. Measurements were made of the cluster mass-spectrum as a function of extent of nucleation, of the variation of appearance potentials with extent of nucleation and of fragment-ion kinetic energies. Results of these measurements lead to the conclusion that not only do the larger water clusters fragment by loss of H2O as well as of OH, but that substantial excess internal and fragment kinetic energy is involved. The utility of ion peak-shape analysis in detecting fragmentation of Argon clusters is illustrated. Author (TAB)

N70-43177 National Lending Library for Science and Technology, Boston Spa (England).
METHODS FOR CALCULATING THE MAXIMUM DEPTH TO WHICH THE SOIL FREEZES
M. V. Zavarina 29 May 1970 12 p refs Transl. into ENGLISH from Glav. Geof. Obs., T. Vyp. (Leningrad), v. 246, 1969 p 73–82
(NLL-M-9151-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A method of calculating cumulative frequencies of the depth to which a temperature of 0 C penetrates into the soil and the cumulative probability of the values is presented. The method is based on monthly hydrometeorological data on the maximum depth. N.E.N.

N70-43178 National Lending Library for Science and Technology, Boston Spa (England).
STABLE STRATIFICATION OF OCEAN WATER MASSES AND ASSOCIATED CURRENT SYSTEMS
A. Defant 29 May 1970 36 p refs Transl. into ENGLISH from Veroeffentl. Inst. Meereskunde (Berlin), 1929 p 1–33
(NLL-M-9072-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

A discussion on sea structure and its stability is presented. Topics described include stable boundary surfaces between mobile water bodies, water bodies stably situated within those of different nature, physical processes at boundary faces between water bodies, and stable currents in a stratified ocean. It is felt that taking boundary conditions and their compensation currents into account overcomes the difficulty with hydrodynamic equations in which relative but not absolute current distribution appears. N.E.N.

N70-43189# Environmental Research Corp., Alexandria, Va.
EFFECTS OF LOCAL GEOLOGY ON THE AMPLITUDES OF SEISMIC WAVES, VOLUME 1
J. R. Murphy, N. L. Weaver, and G. B. Lamers Jun. 1970 111 p refs
(Contract AT(29-2)-1163)
(NVO-1163-205-Vol-1) Avail: NTIS

A comprehensive examination of the amplification of ground motion by near surface site geology from both the analytical and experimental viewpoints is presented. The mathematical models available to describe amplification are presented and their limitations indicated. A useable experimental amplification factor is defined in such a way that it is meaningful in terms of the available mathematical models. Experimental amplification factors are obtained for a wide variety of site geologies, ground motion intensities and epicentral distances. The observations are compared with the output of the various analytical models and the validated models are subjected to a thorough parameter study. The major conclusions are that extrapolations from weak motion measurements are valid in some applications, and that the analytic models are generally adequate for the description of the trend of the observed amplifications for the site geologies investigated. Author (NSA)

N70-43190# Environmental Rsearch Corp., Alexandria, Va.
A CONTRIBUTION TO THE ANALYSIS OF SEISMIC DATA FROM CRATERING AND CONTAINED EVENTS. SCHOONER EVENT
W. W. Hays, R. A. Mueller, and C. T. Spiker, Jr. 18 Jul. 1969 108 p refs
(Contract AT(29-2)-1163)
(PNE-522) Avail: NTIS

Schooner, a nuclear cratering detonation, provides experimental verification of scaling theory. Comparison of the seismic data observed from Schooner and other cratering and contained detonations shows several basic differences in the characteristics of the ground motion. The shallow depth of burial of the cratering detonation causes the seismic energy efficiency to be significantly diminished. The spectral composition of the ground motion generated by a cratering detonation is characterized by a lower amplitude level and a shift to the low frequency end of the spectrum. The general deficiency of high frequencies causes the peak vector particle velocities and accelerations to be lower than mean values predicted on the basis of experience with equivalent yield contained detonations. The peak vector particle velocity correlates almost exclusively with the surface wave mode time window for cratering detonations. The level of peak vector particle acceleration and velocity recorded from a cratering detonation at instrument sites located on alluvium is significantly reduced. Author (NSA)

N70-43191# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR OCTOBER 1968 FROM WOOMERA, SOUTH AUSTRALIA
Feb. 1970 29 p *Its* Ionospheric Data Bull. SAD 1968/10(W)
Avail: NTIS

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for October 1968. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N70-41807* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL TELEVISION CAMERA CONTROL SYSTEM Patent
Leonard R. Malling, inventor (to NASA) Issued 22 Nov. 1966 (Filed 5 Nov. 1963) 6 p Cl. 178-7.2 Sponsored by NASA
(NASA-Case-XNP-01472; US-Patent-3,287,496;
US-Patent-Appl-SN-321656) Avail: US Patent Office CSCL 17B

A device responsive to video signals from a TV camera tube for maintaining the output signal level within optimum limits, even in the presence of extreme variations in light intensity, is described. Regulation of the video output signal is done by varying a scale factor relating the light intensity to the output signal level. The scale factor may be varied by controlling the gain of the vidicon tube or by varying the time the tube target is exposed to the field of view. N.E.N.

N70-41812* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
DISCRETE LOCAL ALTITUDE SENSING DEVICE Patent
Carlisle C. Campbell, Jr., Joseph A. Chandler, and Thomas M. Grubbs, inventors (to NASA) Issued 7 Feb. 1967 (Filed 23 Dec. 1965) 6 p Cl. 200-61.45
(NASA-Case-XMS-03792; US-Patent-3,303,304;
US-Patent-Appl-SN-516159) Avail: US Patent Office CSCL 01D

A device for use with descending space vehicles as an altitude sensor is described for detecting a predetermined discrete altitude for transmitting a firing signal to the vehicle retrorocket system for reducing the vertical velocity to safe landing speeds on land surfaces. The sensor is deployed by dropping it beneath the vehicle after the parachutes have opened. The length of conduit for holding a hemispherical bumper containing a multiplicity of switches depends on the altitude desired for retrorocket actuation, which occurs upon impact of the bumper with the landing surface. F.O.S.

N70-41821# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
NEUTRON FLUX SPECTROMETER WITH NEARLY CONSTANT SENSITIVITY OVER THE ENERGY RANGE THERMAL TO 15 MeV
J.P. Longworth Mar. 1970 38 p refs
(RD/B/N-1416) Avail: AEC Depository Libraries

A neutron flux spectrometer, whose sensitivity varies by a factor of only 2.7 over the energy range thermal to 14 MeV, is described. The DELTA (Density of Linear Thermalization) spectrometer consists of LiF thermal neutron detectors spaced at intervals along the axis of a cylindrical moderator and is a directional device. The theoretical best resolution of the spectrometer varies from some 12% at low energies to about 5% at 10 MeV when the measured thermal neutron flux is known to + or − 2%. The basic principles and detailed manufacture of the DELTA neutron spectrometer, the method of its experimental and theoretical calibration, and the final response matrix are described. Author (NSA)

N70-41882# Technische Univ., Berlin (West Germany). Inst. fuer Kerntechnik.
RADIATION DETECTORS: A PROGRAMMED INTRODUCTION [STRAHLUNGSDETEKTOREN: A PROGRAMMIERTE EINFUEHRUNG]
Erwin Lindauer Mar. 1970 113 p refs In GERMAN
(TUBIK-20) Avail: AEC Depository Libraries

A workbook manual on radiation detectors is presented. The physical basis for nuclear radiation measurement techniques, operational principles of the individual classes of detectors, types of gas-filled detectors, and properties of different detectors are considered. NSA

N70-41916*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SINUSOIDAL PRESSURE GENERATOR FOR TESTING PRESSURE PROBES
Ted W. Nyland [1970] 10 p refs Presented at the 25th Ann. Conf. of the Instr. Soc. of Am., Philadelphia, 26—29 Oct. 1970
(NASA-TM-X-52873) Avail: NTIS CSCL 14B

The generator is capable of producing sinusoidal pressures at frequencies between 300 and 5000 Hz with peak-to-peak pressure amplitudes to 5 psi. Two similar generators were constructed, one of which oscillates around atmospheric pressure, and the second of which oscillates around adjustable static pressure levels to 120 psig. The generator design is based on the use of a resonant air column which is set into oscillation by the impingement of an annular air jet on circular shaped sharp edge. The frequency of oscillation is varied by adjustment of a tuning piston which varies the air column length. The generator is constructed from a 1 inch o.d. tube 13 inches long. Instrumentation for making frequency, amplitude, and phase angle measurements is described. Data describing operating conditions and wave shape distortion are given. The generator is useful in determining the frequency response of small pressure transducers, pressure probes, and characteristics of small diameter infinite lines. Author

N70-41946* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
INSTRUMENT FOR THE QUANTITATIVE MEASUREMENT OF RADIATION AT MULTIPLE WAVE LENGTHS Patent
Carmon M. Auble and Marcus Frank Heidmann, inventors (to NASA) Issued 15 Nov. 1960 (Filed 16 May 1958) 5 p Cl. 88-14
(NASA-Case-XLE-00011; US-Patent-2,960,002;
US-Patent-Appl-SN-735911) Avail: US Patent Office CSCL 18D

An apparatus for determining the temperature of a hot body or gas is described which is relatively small in size, weight, and number of required elements. Lens systems and their consequent alignment are eliminated. The calibrating elements form a permanently placed and integral part of the unit; calibration may therefore be accomplished without readjustment of the optical elements. Light emanating from the radiation source passes through an elongated straight tube projecting from a casing, is collimated, and upon exit impinges on a dichroic mirror inside the casing. This mirror splits the incident light into two component beams of different colors or wavelengths, one beam being reflected light and the other being transmitted. A pair of photocells are positioned so as to be acted upon by the beams to develop electrical signals having an amplitude representative of the respective beam. A dual channel cathode ray oscilloscope alternatively displays the signals from the energy source and from the calibration lamp used as a reference signal, and a camera records the displays to provide a comparison record. P.A.B.

N70-41955* Packard-Bell Electronics Corp., Newbury Park, Calif.
OPTICAL ALIGNMENT SYSTEM Patent
Robert Edward Bishop, Kenneth R. Jackson, George Kis, and Frank Wagner Schlesinger, inventors (to NASA) Issued 6 Jun. 1967 (Filed 4 Sep. 1962) 7 p Cl. 88-14 Sponsored by NASA
(NASA-Case-XNP-02029; US-Patent-3,323,408;
US-Patent-Appl-SN-221278) Avail: US Patent Office CSCL 20F

An electro-optical computer apparatus is described for aligning a large cylindrical member in a predetermined fixed position and then maintaining that position. The member may be a space vehicle or a structural member of a bridge, building, or pipeline. The

electro-optical equipment projects a light beam rotating about an optical axis, a reflector on the member, a beam splitter for deflecting the reflected beam along a second axis normal to the first, and photoelectric cells which indicate the relative position of the cylindrical member. The computer receives signals from the photoelectric cells and relays them to the alignment system mounted on the member. N.E.N.

N70-41957* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FORCE TRANSDUCER Patent
Vernon L. Rogallo, inventor (to NASA) Issued 21 Feb. 1967 (Filed 26 Mar. 1964) 11 p Cl. 73-141
(NASA-Case-XAC-01101; US-Patent-3,304,773; US-Patent-Appl-SN-355129) Avail: US Patent Office CSCL 14B

A transducer capable of detecting and measuring extremely small forces is described. The device consists of a base plate with a support post extending vertically. A pair of piezoelectric beams is mounted one above the other and is attached rigidly to the support post. A movable member connected to the free ends of the beams transmits the force to be detected and measured. Bending of the beams by the movable member generates an electrical output and the magnitude of the output indicates the amount of force transmitted to the movable member. The device is designed for use as a micrometeoroid detector or for detection of other scattered impacts. R.B.

N70-41969# Kentucky Research Foundation, Lexington. Dept. of Chemistry.
AC-DC POLAROGRAPH Scientific Interim Report
D. Britz, F. M. Hawkridge, and H. H. Bauer Feb. 1970 28 p refs
(Contract DAAB07-69-C-0366; Proj. Themis)
(AD-708881; THEMIS-UK-RR-8) Avail: NTIS CSCL 7/4

Operational-amplifier circuits for a multipurpose polarograph capable of d.c., fundamental a.c., second-harmonic, and phase-selective a.c. polarography are given. Details of operation in the various modes are described. Author (TAB)

N70-41994* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
POSITIVE DISPLACEMENT FLOWMETER Patent
Frederic E. Wells, inventor (to NASA) Issued 6 Jun. 1967 (Filed 14 Oct. 1964) 6 p Cl. 73-194
(NASA-Case-XMF-02822; US-Patent-3,323,362; US-Patent-Appl-SN-403959) Avail: US Patent Office CSCL 20D

The described flowmeter consists of a liquid dispenser that releases a measured quantity of a sealing liquid or fluid from a reservoir into a metering tube of a known volume located between the inlet and outlet port of the system. Since the liquid forms a slug that seals off the inlet port from the outlet port, the liquid is forced through the metering tube at a rate dependent on the flow of fluid into the system. The time required for the liquid slug to be transported a predetermined distance through the metering tube determines the flow rate of the fluid under test. Once the liquid slug leaves the metering tube it is returned to the reservoir through a separator and return unit, making the system ready for immediate reuse. R.B.

N70-42036# National Bureau of Standards, Washington, D.C. Center for Radiation Research.
DEVELOPMENT AND CURRENT STATUS OF THE STANDARD NUCLEAR INSTRUMENT MODULE (NIM) SYSTEM
Louis Costrell Oct. 1970 17 p refs
(NBS-TN-556) Avail: SOD $0.30

A history of standard nuclear instrument module (NIM) development is presented with a review of the NIM system status. The NIM system has become dominant for nuclear instrumentation in most of the world and has contributed substantially to experimental nuclear physics. The system has the potential for providing to other fields the same advantages that have accrued to nuclear and radiation physics. Author

N70-42074* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID FLOW SIGHT ASSEMBLY Patent
Herbert L. Minkin and Howard F. Hobart, inventors (to NASA) Issued 6 Jun. 1967 (Filed 27 Dec. 1965) 5 p Cl. 116-117
(NASA-Case-XLE-02998; US-Patent-3,323,484; US-Patent-Appl-SN-516794) Avail: US Patent Office CSCL 20D

The sight assembly can accommodate high pressure fluids over a wide range of temperatures, free of fluid turbulence or eddying. An enlarged portion in a fluid conduit has oppositely disposed sight members and contains a thin walled glass tube longitudinally disposed and extending, at each of its ends, into the adjacent conduit. The glass tube is retained in position by snap rings detachably secured to the inner conduit wall at each end of the tube. This glass tube is dimensioned in length and in cross sectional size to provide a controlled leak for pressurized fluid flow to the conduit enlarged portion, to equalize fluid pressure interiorly and exteriorly of the tube and thus prevent breakage. For cryogenic fluids, the assembly is retained in a vacuum jacket with oppositely disposed sight members in alignment with those of the conduit. The construction is adapted to accommodate liquid hydrogen flow at pressures up to 50 psia. P.A.B.

N70-42133# California Univ., Livermore. Lawrence Radiation Lab.
METHOD FOR EVALUATION AND CERTIFICATION OF THE SHEFFIELD 20-INCH ROTARY CONTOUR GAGE
Donald L. Lane 23 Mar. 1970 33 p
(UCRL-50837) Avail: NTIS

The 21 evaluation and certification tests developed for the Sheffield 20-in. rotary contour gage are described. Photographs of each test setup are included. Author

N70-42141# Joint Publications Research Service, Washington, D.C.
AIRBORNE INFRARED FOURIER SPECTROMETER
M. N. Markov et al 22 Sep. 1970 31 p refs Transl. into ENGLISH from the Russian
(JPRS-51426) Avail: NTIS

The development of a small airborne Fourier spectrometer was investigated for measuring absolute spectral intensities of the radiation from the earth and other planets in the wavelengths from 10 to 40 microns. The classical interferometer arrangement as the basis of the Fourier spectrometer, and the airborne infrared Fourier spectrometer are described. The spectrometer construction, interferogram recording, the determination of characteristics, and testing of the instrument are discussed. F.O.S.

N70-42178*# Battelle Memorial Inst., Columbus, Ohio.
STUDY OF TEST AND MEASUREMENT STANDARDIZATION TECHNIQUES ASSOCIATED WITH THERMOELECTRIC MATERIALS Final Report, Nov. 1969 – Aug. 1970
15 Sep. 1970 46 p refs
(Contract NAS5-21099)
(NASA-CR-114240) Avail: NTIS CSCL 14B

A design for segmented thermoelectric couples was successfully developed which eliminates the need for complicated transition members usually required at the interface of materials possessing greatly differing thermal expansivities. As a result, the stresses usually encountered as a result of differing magnitudes of thermal expansion at the hot and cold ends of the thermoelectric couple are minimized. A description of the segmented couple fabrication technique, the results of conversion efficiency measurement, and a description of a new technique for axially

loading couples on test are presented. This latter experimental technique permits application of axial loading pressure thus maintaining a high thermal conductance but not destroying the high degree of flexibility required to insure good electrical contact. In addition, a thermal conductivity measurement technique was developed based on a design employing an ultrafine (0.02 cm diameter) traversing thermocouple. This technique features the rapid determination of thermal conductivity as a function of temperature for specimens operating in the range from 300 up to 1200 K. In contrast to conventional comparative methods of thermal conductivity measurement, the present approach requires only one equilibrium condition, the condition in which the specimen is maintained between the two temperature extremes of interest. Author

N70-42228# Pennsylvania State Univ., University Park. Field Emission Lab.

FIELD ION MICROSCOPY Final Report, 1 Jun. 1969–31 May 1970

Erwin W. Mueller 3 Aug. 1970 13 p refs

(Contract N00014-67-A-0385-0009)

(AD-709985) Avail: NTIS CSCL 14/2

The basic physical effects used in field ion microscopy are not yet fully understood. Field evaporation rates of tungsten were measured in the range from 0.01 to 10,000,000 atomic layers/sec, yielding the polarizability of a kink site surface atom, the activation energy and the pre-exponential of the field evaporation equation. Using the polarizability, the dipole-dipole binding energy of field-adsorbed noble gases ahs been calculated, and a modified mechanism of field ionization and image interpretation is proposed. A high-voltage field ion microscope has been operated at up to 45 kV, giving an increased field of view. Author (TAB)

N70-42367*# Arizona State Univ., Tempe. Solid State Research Lab

INVESTIGATION OF OPTICAL/INFRARED SENSOR TECHNIQUES FOR APPLICATION SATELLITES Final Report

Irving Kaufman Jul. 1970 54 p refs

(Contract NAS12-2173)

(NASA-CR-110775) Avail: NTIS CSCL 20F

Progress is reported for work on optical sensor arrays constructed of piezoelectric and photoconducting materials and excited by short voltage pulses of predetermined shape, to generate output electrical signals that are time analogs of a spatial distribution of light. In the construction of solid state arrays for optical sensing the problem of scanning the sensor elements is of great importance. Work deals with a method of self-scanning of such arrays that employs short acoustic pulses that travel on a piezoelectric medium. In the design originally proposed, this medium is coated with a photoconducting layer. Descriptions are given of: (1) The self-scanning schema. (2) Initial demonstration of the principle of operation. (3) Progess in techniques of generating and controlling acoustic surface waves, including laboratory techniques. (4) Initial efforts of depositing photoconducting material. (5) Demonstration of a multi-element one-dimensional array sensor. (6) Design consideration. (7) Schemes for separating the sensing elements from the piezoelectric line; two-dimensional arrays. Author

N70-42431# Joint Publications Research Service, Washington, D.C.

AUTOMATIC SCANNING

G. P. Katys 6 Oct. 1970 442 p refs Transl. into ENGLISH from the book "Avtomaticheskoye Skanirovaniye" Moscow, Mashinostroyeniye, 1969

(JPRS-51512) Avail: NTIS

A monograph of methods for calculating basic classes of scanning systems is presented, and the general principles of scanning are investigated. The results of studying animal eyes, and possible means of applying these results to scanning systems are indicated. The elements of the theory of efficient construction of scanning systems are discussed with scanning methods. F.O.S.

N70-42454# European Space Research and Technology Center, Noordwijk (Netherlands).

A ROCKET-BORNE, EJECTABLE INSTRUMENT PACKAGE WITH PARACHUTE

R. Berkeljon, G. Englert, R. Jaeschke, D. Koehn, A. Pedersen et al Apr. 1970 30 p

(ESRO-TN-102(ESTEC)) Avail: NTIS

A parachute-borne instrument package for lower ionosphere measurements between 80 and 40 km altitude was developed. The parachute probe is a piggy-back on Skylark rockets, and is built into a standard 8 in. body section. It is ejected from the rocket during ascent and braked by a drag parachute to an apogee of about 80 km. From there the instrument package descends on the main parachute. The package is self-contained, carrying its own telemetry system. The weight during descent is 2.6 kg, including the parachute. The instrument effective volume is a cylindrical box 11 cm in height, having an inner diameter of 13.5 cm. The total weight of the Skylark bay, containing the parachute package and its ejection mechanism, is 18 kg. Author (ESRO)

N70-42518*# Rocketdyne, Canoga Park, Calif.

DEVELOPMENT OF CALORIMETER FOR SPACECRAFT BATTERIES, DESIGN STUDY PHASE Progress Report

W. V. Johnston Sep. 1970 37 p refs

(Contract NAS5-21514)

(NASA-CR-114252; R-8295) Avail: NTIS CSCL 14B

The design of a calorimeter capable of measuring the thermal output of 20 and 100 ampere-hour sealed nickel-cadmium cells is discussed. The calorimeter comprises three main units, an upper portion which contains the calorimetric unit surrounded by an adiabatic shield within a vacuum chamber, a copper rod which conducts the heat from the calorimetric unit to a finned surface immersed in boiling liquid nitrogen, and a lower unit which surrounds the copper rod and minimizes its heat exchange with the surroundings. Author

N70-42520*# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.

PROPERTIES OF AN IONIZATION SPECTROMETER EXPOSED TO 10, 20.5, AND 28 GeV/c MACHINE ACCELERATED PROTONS

W. V. Jones, K. Pinkau, U. Polivogt, W. K. H. Schmidt, and R. W. Huggett 1970 15 p refs Sponsored in part by Deutsche Forschungsgemeinschaft Prepared in cooperation with Max-Planck-Inst. fur Physik und Astrophys.

(Grants NGR-19-001-012; NSF GP-7169)

(NASA-CR-110792; Rept-140) Avail: NTIS CSCL 18D

An ionization spectrometer was employed in several successful balloon flights, in combination with spark chambers and different target materials, to study high energy cosmic rays. The same spectrometer was exposed to 10, 20.5, and 28 GeV/c protons from the alternating gradient synchrotron at Brookhaven, in order to study its response and to calibrate it at these energies. Some results of the calibration measurements are reported here, including the accuracy of energy measurement, the inelastic interaction cross section for protons in iron, and the inelasticity of the interactions of protons with carbon, iron, and lead nuclei. Author

N70-42580# Royal Aircraft Establishment, Farnborough (England).

A PORTABLE CALIBRATING SOURCE FOR IR RADIOMETERS

D. P. Heywood Apr. 1970 14 p

(RAE-TR-70072) Copyright. Avail: NTIS

A source has been developed which enables radiometers to be calibrated quickly in the field. It is temperature stabilised by means of a feedback from a thermocouple and a chopper is fitted to make the radiometer sensitive only to the calibrating source. The

source gives a stable chopped radiation output of 0.18 watts per steradian within two minutes and the radiated field is uniform over a cone of 4 deg. ESRO

N70-42634 National Lending Library for Science and Technology, Boston Spa (England).
ABSOLUTE METHOD OF MONITORING THE FILM THICKNESS DURING VACUUM EVAPORATION [ABSOLYUTNYI METOD KONTROLYA TOLSHCHINY PLENKI NEPOSREDSTVENNO V PROTSESSE EE NAPYLENIYA V VAKUUME]
B. P. Kozyrev Jun. 1970 14 p refs Transl. into ENGLISH from Izv. Lenin. Elek. Inst. (USSR), v. 72, 1968 p 160–173
(NLL-RTS-5783) Avail: Natl. Lending Library, Boston Spa, Engl.: 26s; 4 NLL photocopy coupons

An analysis is given of the existing methods for checking the thickness of the film coatings when they are produced in a vacuum. A new method is put forward for determining the thickness of layers, permitting measurement of film thickness down to 7 A. Author

N70-42665*# Texas A&M Univ., College Station. Remote Sensing Center.
INFRARED DETECTORS: SPECIAL INTEREST BIBLIOGRAPHY WITH ABSTRACTS
Richard H. Arnold, comp. Sep. 1969 27 p refs
(Grant NGL-44-001-001)
(NASA-CR-114177) Avail: NTIS CSCL 17E

Sensor studies for predominantly geoscience oriented programs are conducted to support the data interpretation and analysis activities. A study of infrared detectors resulted in compilation of related literature. The listing is organized into eight sections: detectors, cooling, noise, optics, apparatus, technology, books, and special references. Author

N70-42697*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARATIVE IN-FLIGHT THRUST MEASUREMENTS OF THE SERT 2 ION THRUSTER
William C. Nieberding, Daniel J. Lesco, and Frank D. Berkopec Washington Oct. 1970 24 p refs
(NASA-TN-D-6008; E-5755) Avail: NTIS CSCL 14B

A description and an analysis of the three methods used to measure the thrust of the SERT II ion thrusters in flight are given. The first is the use of the MESA (miniature electrostatic accelerometer) to measure the 2 micro g's resulting from the radial component of the thrust. The second is the use of telemetered beam electrical parameters to calculate thrust. The third is the measurement of orbit change resulting from the thrust. The three methods are shown to yield values of thrust which agree with each other within the error bands of the methods. It is concluded that the thrust was measured to within + or − percent by the MESA, to within + or − 2.2 percent by beam electrical parameters, and to within about + or − 5 percent by orbit changing. Author

N70-42761# Royal Radar Establishment, Malvern (England).
BIBLIOGRAPHY ON TROPIC PROOFING OF OPTICAL INSTRUMENTS
P. W. Baker Oct. 1969 7 p refs
(RRE-TN-747) Copyright. Avail: NTIS

This bibliography of 51 articles was compiled during work on fungicides for a complex optical/electronic unit. Journal articles, patents, etc., which are readily available have been included. Use of the International Biodeterioration Bulletin Reference Index Supplement (IBBRIS), published by the University of Aston, Birmingham, U.K., is stressed. Author (ESRO)

N70-42801# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
DIGITAL OSCILLOSCOPE PLUG-IN UNITS FOR INSTANT WAVEFORM ANALYSIS
J. F. Howell 2 Oct. 1969 36 p
(Contract AT(29-2)-656)
(GEPP-73) Avail: NTIS

This report describes a family of digital instruments that provide measurements such as the integral of a single pulse, duration of a single pulse, time between two pulses, peak amplitudes of a pulse at a specific time. The time interval detector, the peak rate detector, and the gated integrator are packaged as plug-ins for Tektronix oscilloscopes that accept letter series plug-ins. These instruments retain normal analog readout, and in addition, provide automatic, high precision digital interpretation of waveforms. Specifications and circuit diagrams are included. Author (NSA)

N70-42822# Michigan Univ., Ann Arbor. Willow Run Labs.
AN ADVANCED AUTOMATIC TELESCOPE COMPUTER CONTROL PROGRAM
J. D. Erickson, P. Tanner, and C. Fujii Aug. 1970 202 p refs
(Contract DAHC15-68-C-0144)
(AD-710414; Rept-1386-27-T) Avail: NTIS CSCL 17/8

The report describes the major features of a modular, advanced, automatic telescope digital control program (TEST), used at the Mount Haleakala Observatory for automated, sampled-data control of one 60-in.- and two 48-in.-aperture telescopes, which may be controlled simultaneously or separately. Among the flexible features of the system are lunar, planetary, and stellar tracking capabilities. Pointing and tracking performance are improved in real time by refraction corrections and mount models which compensate for flexure, collimation error, and other mechanical differences of the telescope from an ideal optical-coordinate system. TEST also contains the logical processing for an infrared scanner-tracker sensor mounted on one of the 48-in. telescopes; this provides an infrared tracking capability. TEST serves an an equipment testing program for the control loop, which features specifiable step, ramp, and various sinusoidal driving functions for each asix. A brief operators guide and logic flow charts are included in the report. Author (TAB)

N70-42824*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLOW VELOCITY AND DIRECTION INSTRUMENT
James H. Monteith (M.S. Thesis – Va. Univ.) Aug. 1970 64 p refs
(NASA-TM-X-66391) Avail: NTIS CSCL 14B

Analyses and experimental results are presented on a control system used for positioning a null seeking pressure probe. The probe is to be used in wind tunnels to measure wind velocity magnitude and direction. Two, interacting, positioning servomechanisms were used to control the pressure probe. The analysis of this system was accomplished using vector analysis as well as standard servoanalysis methods. These analyses showed the stability of the system to be dependent on the orientation of the null sensing pressure ports on the probe face. Laboratory and wind tunnel tests showed that the probe yaw and pitch angle measurements were accurate to within + or − deg for angles up to 45 deg. Author

N70-42942# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France).
INTRODUCTION TO MASS SPECTROSCOPY: PRINCIPLE OF THE FIRST MASS SPECTROGRAPHS AND SPECTROMETERS [INTRODUCTION A LA SPECTROSCOPIE DE MASSE. PRINCIPE DES PREMIERS SPECTROGRAPHES ET SPECTROMETRES DE MASSES]
Roger Schott May 1970 46 p refs In FRENCH; ENGLISH summary
(CEA-R-3966) Avail: NTIS

The achievements of J. J. Thomson and Aston in designing mass spectrometers are reviewed and the developments by Dempster, Bainbridge, and Herzog are described. ESRO

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N70-41808* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
INDEXED KEYED CONNECTION Patent
William H. Simmons and Lyle M. Jenkins, inventors (to NASA) Issued 22 Nov. 1966 (Filed 21 Sep. 1964) 6 p Cl. 285-27
(NASA-Case-XMS-02532; US-Patent-3,287,031; US-Patent-Appl-SN-398132) Avail: US Patent Office CSCL 13E

The designs of easily produced standard couplings, such as are used on initiators in spacecraft, are described. The female coupling contains a series of longitudinal slots around the inner periphery of the chamber which receives the male coupling. Plugs are fitted into all slots at time of manufacture, and at installation the desired one or more plugs are removed to provide a predetermined pattern. The standard male coupling has a series of keys, one or more being removed at installation to provide a matching pattern. N.E.N.

N70-41811* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANTIFLUTTER BALL CHECK VALVE Patent
William F. MacGlashan, Jr., inventor (to NASA) Issued 7 Feb. 1967 (Filed 21 May 1964) 3 p Cl. 137-539 Sponsored by NASA
(NASA-Case-XNP-01152; US-Patent-3,302,662; US-Patent-Appl-SN-369337) Avail: US Patent Office CSCL 13K

An antiflutter ball check valve is described which is adapted for use where the pressure differential across the valve is high causing high velocity flow. The device incorporates a spring continuously engageable with the ball so as to prevent flutter, and a baffle is provided for directing the flow of fluid through the valve to avoid fluid impact against the retainer spring. F.O.S.

N70-41820# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
CHEMICAL POLISHING OF IRRADIATED NICKEL AND STAINLESS STEEL
J. E. Harbottle May 1970 4 p refs
(RD/B/N-1663) Avail: AEC Depository Libraries

Oxides produced during reactor irradiation of bulk specimens of nickel and stainless steel were found to be more resistant to removal by electro- and chemical-polishing than the oxides on unirradiated material. A description is given of chemical polishing treatments for the irradiated metals that proved to be both rapid and effective. Author (NSA)

N70-41823# Sandia Corp., Albuquerque, N.Mex. Engineering Div.
DEVELOPMENT OF A PRESSURE DAMPENING VALVE
R. L. Jones Jul. 1970 17 p Supersedes SCL-TM-70-204
(Contract AT(29-1)-789) (SCL-DR-70-99; SCL-TM-70-204) Avail: NTIS

A pressure dampening valve was designed to protect a gage or low pressure transducer from high pressure surges. The valve consists of six parts: two machined mating halves, a rubber O ring, a light weight nylon ball, a spring, and an internal adjustment screw. Author

N70-41824# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
SEPARATION OF ZIRCONIUM AND HAFNIUM, AND THE PREPARATION OF HAFNIUM DIOXIDE BY THE METHOD OF SELECTIVE EXTRACTION OF THE THIOCYANATE FROM ETHYL ACETATE
I. V. Vinarov et al Apr. 1970 10 p refs Transl. into ENGLISH from Ukr. Khim. Zh. (USSR), v. 34, 1968 p 153–155 In ENGLISH and RUSSIAN
(LIB-Trans-269) Avail: AEC Depository Libraries

Distribution coefficients and separation factors were determined for zirconium and hafnium thiocyanates extracted from sulfuric acid solutions. A method is suggested for separation of Zr and Hf technical mixtures and for preparation of Hf oxides by selective thiocyanate extraction with ethyl acetate. The method was used for separating a large amount of HfO2 from concentrates. NSA

N70-41829* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LOCKING DEVICE WITH ROLLING DETENTS Patent
Adolf L. Herrmann, inventor (to NASA) Issued 7 Feb. 1967 (Filed 20 Mar. 1964) 7 p Cl. 287-119
(NASA-Case-XMF-01371; US-Patent-3,302,960; US-Patent-Appl-SN-353634) Avail: US Patent Office CSCL 13E

A ball locking device which releases in response to small forces when subjected to high axial loads is described. The device is considered applicable to rocket launching for releasing the vehicle from the permanently fixed supports. One of the locked members has an aperture with two balls; one ball is adapted to move in and out of locking position in response to movement engaging the other ball. F.O.S.

N70-41940# Watervliet Arsenal, N.Y.
REQUIREMENTS FOR DIGITAL CONTROL OF ELECTROPLATING PROCESS
John W. Pym and Chi-neng Shen Apr. 1970 24 p refs
(AD-708858; WVT-7023) Avail: NTIS CSCL 13/8

Various modes of control for an electroplating process are discussed. The advantages of a digital system for such control are presented and compared to an analog system. The equipment necessary to implement the digital control system is specified. Author (TAB)

N70-41956*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
CABLE STABILIZER FOR OPEN SHAFT CABLE OPERATED ELEVATORS Patent Application
Edwin Joseph Davis and Bill A. Tolson, inventors (to NASA) Filed 6 Aug. 1970 17 p
(NASA-Case-KSC-10513; US-Patent-Appl-SN-61535) Avail: NTIS CSCL 13E

A guide member through which the cables of the elevator pass is provided for aiding in preventing the cables from swaying in the wind. A pair of stops are carried on the guide rails so as to prevent the guide member from dropping below an intermediate location. When the elevator compartment is raised above the intermediate location it, in turn, causes the guide member to be raised. NASA

N70-41960* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PRINTED CIRCUIT BOARD WITH BELLOWS RIVET CONNECTION Patent
Clarence W. Gould, inventor (to NASA) Issued 23 May 1967 (Filed 19 Jan. 1966) 4 p Cl. 174-68.5 Sponsored by NASA
(NASA-Case-XNP-05082; US-Patent-3,321,570; US-Patent-Appl-SN-521753) Avail: US Patent Office CSCL 13E

An electrical connection is provided between the circuits on opposite sides of a common board by relieving the axial and/or

transverse stresses imposed on the connection by vibrations or high temperatures. A bellows principle employed in the connection rivet allows the connection to expand and contract. P.A.B.

N70-41979*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BREAKAWAY CONNECTOR Patent Application
Leonard Katzin, inventor (to NASA) Filed 29 Feb. 1970 25 p
(Contract NAS7-100)
(NASA-Case-NPO-11140; US-Patent-Appl-SN-15019) Avail: NTIS CSCL 09A

A breakaway connector particularly suited for use in connecting cable ends of multiwire cables is described. The device consists of a separable pair of juxtaposed connector units, each including a group of laterally spaced electrical terminals coupled with adjacent ends of selected circuit leads. Flexible connector leads are provided, each being of a unique length and serving to interconnect adjacent terminals of the mated units in such a manner that as the pair of units is separated the flexible leads are tensioned sequentially to develop a stress sufficient to rupture them. Sequential separation of the group of leads is achieved through application of a tensioning force having a magnitude sufficient for rupturing a single lead as separation of the connector units occurs. NASA

N70-41982*# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
AREAS OF CONTACT AND PRESSURE DISTRIBUTION IN BOLTED JOINTS
H. H. Gould and B. B. Mikic Jun. 1970 137 p refs
(Contract NAS8-24867)
(NASA-CR-102866; DSR-71821-68) Avail: NTIS CSCL 13E

The pressure distributions in the contact zones and the radii at which flat and smooth axisymmetric, linear elastic plates will separate were computed for several thicknesses as a function of the configuration of the bolt load by the finite element method. The radii of separation were also measured by two experimental methods. One method employed autoradiographic techniques. The other method measured the polished area around the bolt hole of the plates caused by sliding under load in the contact zone. The sliding was produced by rotating one plate of a mated pair relative to the other plate with the bolt force acting. The computational and experimental results are in agreement and these yield smaller zones of contact than indicated by the literature. It is shown that the discrepancy is due to an assumption made in the previous analyses. The finite element and heat transfer computer programs used in the study are included, along with instructions for the use of these programs. Author

N70-41993* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPARATUS FOR POSITIONING AND LOADING A TEST SPECIMEN Patent
Alan Arias, inventor (to NASA) Issued 6 Jun. 1967 (Filed 7 Jul. 1964) 7 p Cl. 73-100
(NASA-Case-XLE-01300; US-Patent-3,323,356;
US-Patent-Appl-SN-380960) Avail: US Patent Office CSCL 14B

An apparatus for testing metallic and nonmetallic solid materials by bending at high temperatures in a vacuum or inert atmosphere is described. The modulus of elasticity or rupture of a beam or rod is determined by subjecting the specimen to three or four point loading. The test specimens can be removed or interchanged while the testing device is mounted within the furnace. R.B.

N70-41997*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
JOINING TECHNIQUES FOR FABRICATION OF COMPOSITE AIR-COOLED TURBINE BLADES AND VANES
A. Kaufman, T. F. Berry (GE, Cincinnati), and K. E. Meiners (Battelle Mem. Inst., Columbus, Ohio) [1970] 23 p refs Proposed for presentation at Gas Turbine Conf. and Prod. Show, Houston, Tex., 28 Mar.–1 Apr. 1971; sponsored by ASME
(NASA-TM-X-52877) Avail: NTIS CSCL 13H

Activated diffusion brazing studies and gas pressure welding studies for joining Udimet 700 and TD NiCr finned shells to B1900 and Rene 80 struts are presented. These results include shear, tensile, and stress rupture data at 1750 F. Effects of oxidation exposure and thermal cycling are also discussed. Problems and advantages associated with applying each of these joining methods to various composite blade or vane cooling configurations are evaluated. Author

N70-42004 National Lending Library for Science and Technology, Boston Spa (England).
THE VISCOSITY PROPERTIES AND BEHAVIOUR OF LUBRICATING GREASES IN ANTI-FRICTION BEARINGS [VYAZKOSTNYE AVOISTVA I POVEDENIE KONSISTENTNYKH SMAZOK V PODSHIPNIKAKH KACHENIYA]
M. D. Bezborodko Jul. 1970 24 p ref Transl. from Podshipnik (USSR), no. 2, 1953 p 8–14
(NLL-RTS-5354) Avail: Natl. Lending Library, Boston Spa, Engl.: 52s; 9 NLL photocopy coupons CSCL 11/8

The resistance developed in grease filled bearings at different temperatures and rotation speeds is evaluated including the relation between bearing resistance torques and viscous properties. The behavior of unloaded ball bearing and roller bearing assemblies packed with grease was examined. Calcium soap and lithium soap greases capable of operating over wide temperature ranges were selected for high pressure, constant flow, capillary viscometric tests. Flow curves of the ratio between mean deformation rate in the capillaries and shear stress on the capillary wall are given with torque graphs. The apparatus used in studying bearing resistance to rotation is described and oil and grease behavior in antifriction bearings for given operating conditions are summarized. The dependence of rotation resistances on temperature and bearing rpm corresponds to the viscosity-temperature and viscosity-speed characteristics of the greases. There is a nonuniform stress situation causing grease deformations in bearings and capillaries. The qualitative relationship between shear systems in capillaries and bearings is established by comparing the mutually intersecting flow curves and torque graphs. J.M.

N70-42017* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LINE CUTTER Patent
Joseph A. Chandler and Thomas M. Grubbs, inventors (to NASA) Issued 23 May 1967 (Filed 8 Sep. 1965) 5 p Cl. 30-228
(NASA-Case-XMS-04072; US-Patent-3,320,669;
US-Patent-Appl-SN-485960) Avail: US Patent Office CSCL 13I

A device is described for cutting control lines on parachutes when the load connected to them is likely to descend on a body of water. The device comprises a piston-in-bore type cutter in which the piston's dynamic force is utilized to sever the cable and to pressurize a viscous grease housed in the bore end. The grease, upon impact by the piston, seals the space between the piston and the cable hole or eye to prevent leakage into the load. R.B.

N70-42033* Ryan Aeronautical Co., San Diego, Calif.
MASKING DEVICE Patent
Donald H. Gaston, inventor (to NASA) Issued 6 Jun. 1967 (Filed 1 Jun. 1964) 4 p Cl. 156-345 Sponsored by NASA
(NASA-Case-XNP-02092; US-Patent-3,323,967;
US-Patent-Appl-SN-371856) Avail: US Patent Office CSCL 13I

A masking boot to be fitted on portions of a workpiece while other portions are exposed to etching solution is described. The boot is composed entirely of flexible material such as rubber and covers the workpiece except for an area slightly larger than that to be milled. The edges are sealed to the workpiece and a vacuum is drawn between the boot and the workpiece. Masking

material is applied around the sealed edges of the boot and is trimmed to expose the exact area to be etched. The masking boot may be reused, and only a small amount of masking material is needed for each operation. N.E.N.

N70-42034* Hughes Aircraft Co., Los Angeles, Calif.
SAMPLE COLLECTING IMPACT BIT Patent
Victor A. Peckham, Jr., inventor (to NASA) Issued 23 May 1967 (Filed 19 Jan. 1965) 4 p Cl. 175-310 Sponsored by NASA
(NASA-Case-XNP-01412; US-Patent-3,321,034; US-Patent-Appl-SN-426702) Avail: US Patent Office CSCL 13I

A bit having means for collecting and storing rock cuttings produced by the operation of the bit is described. Deflecting teeth are mounted on a series of terraces or annular ledges of increasing diameter, and grooves are provided to guide the cuttings in an upward direction into the collecting chamber above the bit. The impact bit operates without lubricating fluids and can be used in an essentially atmosphere free environment such as the lunar surface. N.E.N.

N70-42081*# Martin Marietta Corp., Orlando, Fla. Advanced Manufacturing Technology Dept.
DEVELOPMENT OF AN ADVANCED MICROELECTRONIC CONNECTION WELDING SYSTEM Final Report
William G. Cunningham and Ralph R. Braswell Mar. 1970 44 p refs
(Contract NAS8-24490)
(NASA-CR-102871; OR-10639) Avail: NTIS CSCL 13H

A prototype infrared radiation feedback control system for the microweld process has been developed. The feasibility of applying feedback control to the microwelding process has been demonstrated. A laboratory model of the control system was breadboarded and numerous welds were made. The system demonstrated that within its control range wide fluctuations in power supply energy setting had small effects on the pull strength of welds. Author

N70-42095*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RELIABILITY TESTING AND DEMONSTRATION SESSIONS IV C, E Lecture Notes
Vincent R. Lalli [1970] 51 p refs 8th Ann. Reliability Eng. and Management Inst. held in Tucson, Ariz., 2-11 Nov. 1970; sponsored by Ariz. Univ.
(NASA-TM-X-52900) Avail: NTIS CSCL 14D

Lecture notes covering reliability testing are outlined including application of statistical methods and a case history of the SERT 2 reliability program. Failure, reliability, failure rate, and hazard rate functions are emphasized. The calculation of confidence limits for normal, lognormal, binomial, and Poisson functions are covered. Specific cases are considered to show how analytical or graphical statistical methods can be used in summarizing test data. J.M.

N70-42166*# Hydronautics, Inc., Laurel, Md.
AN INVESTIGATION OF TANDEM ROW HIGH HEAD PUMP INDUCERS Final Report
Robert J. Etter May 1970 178 p refs
(Contract NAS8-20625)
(NASA-CR-110790; TR-703-9) Avail: NTIS CSCL 13K

The performance of tandem row pump inducers is investigated for use in conventional liquid fueled rocket engine systems such as those used in the Saturn 5 launch vehicle and in recoverable engine systems such as those used in space shuttle vehicles. The tests indicate that the constant pressure cambered supercavitating cascade theory is overly optimistic in predicting the lift performance of high stagger angle cascades. The theory for supercavitating cascades of cambered foils appears to agree well with the test data, provided that the flow is nearly two-dimensional and that supercavitating conditions exist. The optimum design is a tandem inducer using a supercavitating first stage and subcavitating second stage operating over a wide range of suction specific speeds and flow coefficients. Author

N70-42191*# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
AN ANALYTICAL MODEL FOR THE PREDICTION OF VISCOSEAL PERFORMANCE IN THE REGIME FROM CONTINUUM TO FREE-MOLECULE FLOW
Kerry E. Patterson (M.S. Thesis) Aug. 1970 88 p refs
(Grant NGR-43-001-023)
(NASA-CR-114239; AE-70-023-7) Avail: NTIS CSCL 13A

The rarefied-gas viscoseal model proposed by Hodgson was investigated. Modifications to his basic model are made to make its application more general. The modified-Hodgson model is used to predict seal leakage rates. Newton's method is applied to solve for the pressure difference. An improved analytical model is developed to predict continuum and slip regime performance. This model leads to an explicit determination of the zero flow pressure difference and also lends itself to predicting optimum seal geometries. An optimization procedure is developed and applied to a specific application. Comparison of the two models with available continuum data shows that the agreement with the improved model is good, while the modified-Hodgson model shows only fair agreement. The improved model also shows good agreement with rarefied sealing coefficient and leakage data. The modified-Hodgson model agrees well with the more rarefied sealing coefficient data available, but its agreement with slip regime data is poor. Author

N70-42261# Rice Univ., Houston, Tex. Dept. of Mathematical Sciences.
ONE MACHINE DETERMINISTIC JOB-SHOP SCHEDULING WITH PRECEDENCE RELATIONS AND DEFERRAL COSTS
Jeffrey Bruce Sidney (Ph.D. Thesis) Jul. 1970 94 p refs
(Contract DA-31-124-ARO(D)-0767)
(AD-709631; TR-476-031-3; AROD-8802-2-M) Avail: NTIS CSCL 13/8

An n-job, one machine deterministic job shop is considered. Author (TAB)

N70-42305# Rice Univ., Houston, Tex. Dept. of Mathematical Sciences.
A COMMENT ON A PAPER OF MAXWELL
Jeffrey B. Sidney 1 Jul. 1970 6 p refs
(Contract DA-ARO(D)-31-124-70-G42)
(AD-709632; TR-476-031-2; AROD-8802-3-M) Avail: NTIS CSCL 13/8

In a paper On Sequencing n Jobs on One Machine to Minimize the Number of Late Jobs, Maxwell presents an integer programming formulation (which is called P) of a one-machine job-shop problem, and attempts to prove the validity of Moores optimal algorithm by applying cutting plane constraints to the program P. Unfortunately, Maxwells proof is incorrect. This brief note, locates Maxwells error, and presents an example which casts doubt on the possibility of minor modifications being sufficient to correct the proof. Author (TAB)

N70-42338*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF HUMIDITY AND A WETTABILITY ADDITIVE ON POLYPHENYL ETHER BOUNDARY LUBRICATION OF STEEL IN AIR AND NITROGEN TO 350 C
William R. Jones, Jr. and William F. Hady Washington Oct. 1970 17 p refs
(NASA-TN-D-6055; E-5819) Avail: NTIS CSCL 11H

A pin-on-disk sliding friction apparatus was used to determine the effect of humidity and a wettability additive on boundary lubrication of steel in air and nitrogen with a polyphenyl ether. Poor wettability was observed for the ether in dry nitrogen from 150 to 200 C (302 to 392 F) and high wear also occurred in this temperature range. The wettability additive improved the wetting and decreased wear of the ether in dry nitrogen. It increased wear in wet air and had little effect on wear in wet nitrogen and dry air. A relative humidity of 50 percent decreased wear in nitrogen and had little effect on wear in air. Author

N70-42344 National Lending Library for Science and Technology, Boston Spa (England).
RESULTS OF AN INVESTIGATION INTO THE USE OF DOMESTICALLY AVAILABLE ABRASIVE AGENTS FOR SURFACE FINISHING IN VIBRATORY APPLIANCES, PART 1 [WYNIKI BADAN NAD ZASTOSOWANIEM KRAJOWYCH SRODKOW SCIERNYCH DO POWIERZCHNIOWEJ OBROBKI GLADKOSCIOWEJ W URZADZENIACH WIBRACYJNYCH, CZESC 1]
W. Szyrle Jul. 1970 15 p Transl. into ENGLISH from Prace Inst. Mech. Precyzyjnej (Warsaw), v. 16, no. 3(61), 1968 p 76–81
(NLL-RTS-5817) Avail: Natl. Lending Library, Boston Spa, Engl.: 1£ 8s; 5 NLL photocopy coupons

The basic factors in the surface finishing process are the type and shape of the abrasive, the vibration amplitude of the container with its load and the vibration frequency, the type and strength of the chemicals used, and the quantitative proportion of the abrasive to the treated parts. The physical and chemical features of the available abrasive materials are presented. R.B.

N70-42376*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INSTRUMENT BEARING PERFORMANCE IN SPACE AND LABORATORY VACUUM
E. J. Devine, H. E. Evans, and W. A. Leasure Washington Oct. 1970 30 p refs
(NASA-TN-D-6035; G-986) Avail: NTIS CSCL 13I

Instrument-size ball bearings were lubricated with a solid film and were tested in orbit aboard the OV1-13 and in laboratory (ion-pumped) vacuum. The test devices were specially designed, electronically commutated, sealed dc motors. Test samples were the rotor support bearings. Motor speed was 3000 rpm, with a 2-lb axial bearing preload. Results show that the mean operating time to reach 0.3 - in.-oz torque, considered the upper limit for instrument motors, was 3240 hours in orbit and 2140 hours in laboratory vacuum. It is concluded that ion-pumped vacuum systems provide a reasonable simulation of space vacuum for testing self-lubricating instrument ball bearings. Performance in space can be expected to equal or exceed the performance indicated by laboratory vacuum tests. Author

N70-42400*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MICROASPERITY MODEL FOR ELASTOHYDRODYNAMIC LUBRICATION OF A SPINNING BALL ON A FLAT SURFACE
Charles W. Allen and Erwin V. Zaretsky Washington Oct. 1970 20 p refs
(NASA-TN-D-6009; E-5758) Avail: NTIS CSCL 20K

A microasperity elastohydrodynamic (EHD) model was developed for a ball spinning without rolling on a flat surface. The theory was developed by using a sinusoidal surface model in conjunction with existing dry-contact deformation theory and point-contact elastohydrodynamic theory for the microasperities. The computed torques based on this model were compared with experimental torques using the NASA spinning torque apparatus. Fair agreement was obtained between theoretical and experimental results below 300,000 psi maximum Hertz stress. Based on the model presented, microasperity EHD lubrication does not appear to be a primary force in maintaining separation between the opposing surfaces. Author

N70-42401 National Lending Library for Science and Technology, Boston Spa (England).
STRIP CASTING USING MOVING MOULDS
D. Altenpohl 29 May 1970 19 p Transl. into ENGLISH from Z. Metallk. (West Ger.), v. 60, no. 9, Sep. 1969 p 678–683
(NLL-M-9159-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Some characteristic features of individual strip casting processes and the materials used in them are discussed. Combined casting and rolling, the use of a casting wheel and steel strip for mold walls, the Hunter-Douglas process, and the Hazelett process are described. As wire casting derives from casting narrow strip, this process is also treated. The advantages and disadvantages of strip casting are then examined, and the prospects for future development predicted. P.A.B.

N70-42405# Engineering Research Foundation, Trondheim (Norway). Section for Machine Dynamics in Tribology.
TRIBOLOGY OF ROUGH SURFACES. STOCHASTIC MODELS OF HYDRODYNAMIC LUBRICATION
Helge Christensen and Kristian Tonder 26 Feb. 1969 38 p refs
(Contract NTNF-B-2260)
(Rept-10/69-18) Avail: NTIS

The hydrodynamic aspects of rough bearing surfaces are discussed and on the basis of stochastic theory three different forms of Reynolds equation, corresponding to three different types of surface roughness, are described. The mathematical forms of these equations are similar but not identical to the form of the Reynolds equation governing the behavior of smooth, deterministic surfaces. These equations can be solved and this is done in detail for some special bearing cases and the bearing parameters are given. Author (ESRO)

N70-42427# Bristol Aerojet, Ltd., Banwell (England).
THE REMOVAL OF HEAT TREATMENT SCALE FROM TWO VERY STRONG STEELS. THREE PERCENT Cr-Mo-V STEEL AND 18 PERCENT Ni-Co-Mo-Ti STEEL
R. A. Duffin London Min. of Technol. May 1970 27 p refs
(Contract KS/1/0471/CB.43(a)2)
(D-Mat-167) Avail: NTIS

Heat treatment scale sometimes needs to be removed by wet methods and improved methods were sought. Proprietary immersion acid pickles and alkaline cleaners were not very effective. Experiments on anodic pickling in sulfuric acid solutions showed that the most effective acid concentration corresponds to maximum conductivity (S.G. 1.36). A proprietary inhibitor was advantageous in reducing smut formation and uptake of hydrogen. Interruption of the anodic current for a few seconds allowed much lower current densities to be used, and pretreatment of scale on 3% Cr-Mo-V steel and maraging steel in an alkaline solution of sodium gluconate prior to anodic pickling further reduced the current density required. Sustained load tests gave no failure even of specimens anodically pickled in uninhibited acid with interrupted current. Author (ESRO)

N70-42457# MSA Research Corp., Evans City, Pa.
PRODUCT SURVEY. PHASE 1, TASK 2: MOISTURE SEPARATOR DEVELOPMENT PROGRAM
Gunther H. Griwatz 21 Jan. 1970 33 p
(Contract AT(45-1)-2145)
(MSAR-70-9; Rept-2) Avail: NTIS

The commercial availability of products for use in the separation of entrained moisture from gas streams under conditions ranging from standard air to those encountered during a pressurized water reactor loss of coolant incident was surveyed. All known suppliers of separator assemblies and a cross-section of likely component suppliers were contacted. Of 135 potential suppliers contacted, 47 did not reply; 55 could not supply suitable separators or components; 12 proposed to furnish separators while 3 declined; and 18 offered media for separator service. Two separator assemblies, one manufactured by MSA and the other manufactured by York, are on hand for performance test evaluation. No other units are recommended for purchase and testing as will be explained in the body of this report. Testing of media samples has been started at ambient temperature and pressure to identify those best suited for testing at PWR incident conditions. Author (NSA)

N70-42473*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVOLUTE STRIP DEVELOPMENT METHOD FOR FABRICATION OF ROTATIONALLY SYMMETRICAL DOUBLE CURVED SURFACES OF REVOLUTION
Rene E. Chambellan and Eugene J. Pleban Washington Oct. 1970 47 p refs
(NASA-TN-D-6050; E-5782) Avail: NTIS CSCL 13H

A double curved surface of revolution can be approximated by a series of coaxial, single curved surfaces. These surfaces can then be subdivided, in the plane of development, by families of involute curves which define flat curved ribbons. These ribbons can be joined to form the surface of revolution. Applied to heat-exchanger design, the surface of revolution also can be covered by a set of constant-diameter, equispaced cooling tubes. The tubes can be either internal or external to the shell. Author

N70-42476*# Rocketdyne, Canoga Park, Calif. Power Systems Div.
FLEXIBLE ROTOR DYNAMIC ANALYSIS Final Report
F. A. Shen and E. Mogil 1 Jun. 1970 214 p
(Contract NAS3-13219)
(NASA-CR-72740) Avail: NTIS CSCL 13I

A digital computer program was developed to analyze a flexible rotor-bearing system. The program can be used to predict the dynamic performance under various operating conditions. An experimental test program was conducted utilizing a Mark-25 pump rotor in a vacuum to generate spin test data to be used for correlation with results of computer simulations of similar rotor unbalance conditions. The mathematical formulations, the computer program verification, the simulation model, and test results are presented and discussed. Author

N70-42487# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUIPMENT FOR STRAIGHTENING WELDS OF THIN-WALLED SHELL
E. S. Milekhin et al 16 Jun. 1970 15 p refs Transl. into ENGLISH from Tr. Mosk. Vysshee Tekhn. Uchilishche (USSR), no. 133, 1969 p 119–128
(AD-710252; FTD-HT-23-207-70) Avail: NTIS CSCL 13/5

The article describes a process for correcting welds by peening, using a rapid deformation effect for treating welds in small specimen parts in straightening high-strength materials. Due to the short application time of the deforming force in high-speed deformation, the heat which arises in the slip planes of the treated material, resulting from friction, cannot cross over into the surrounding area, thus promoting the plastic deformation process and providing optimal conditions for the metal flow. Also discussed is a specially designed impact device suitable for use in the high-speed process. Author (TAB)

N70-42491 New Mexico State Univ., University Park.
THE LIQUID-GAS EJECTOR
James Russell Miller (Ph.D. Thesis) 1969 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-19118

The operating characteristics of Water Jet Air Aspirators; direct comparison with other vacuum pumps; and the controlling parameters in order to understand the limiting conditions they impose on the efficiency of the ejectors are discussed. A number of commerical ejectors were purchased and subjected to experimental evaluation on a small test stand. Their efficiencies, defined as the energy required to isentropically compress the entrained gas to atmospheric pressure divided by the pressure energy supplied to the motive liquid, were obtained for an operating range from atmospheric pressure to shut-off vacuum. Dissert. Abstr.

N70-42525# Aeroplane and Armament Experimental Establishment, Boscombe Down (England). Technical Services Div.
DEVELOPMENT OF FLIGHT LINE TOOL BOX FOR USE AT A AND AEE
N. Spratt 21 Jul. 1969 15 p
(A/AEE-Note-9001) Avail: NTIS

This report describes the development of a machine used to manufacture tool trays from polystyrene sheet using a temperature/vacuum forming technique. The trays, moulded to suit tools selected by individual tradesmen as being needed for first line servicing of aircraft, enable tradesmen to check quickly that all their tools have been removed from the aircraft on completion of their work. Author (ESRO)

N70-42538 National Lending Library for Science and Technology, Boston Spa (England).
RESIDUAL STRESSES IN THE SURFACE LAYER [OSTATOCHNYE NAPRYAZHENIYA V POVERKNOSTOM SLOE]
Jun. 1970 15 p Transl. into ENGLISH from Razvitie Nauki o Rezanii Metallov (USSR), 1967 p 318–327
(NLL-RTS-5813) Avail: Natl. Lending Library, Boston Spa, Engl.: 24s; 4 NLL photocopy coupons

The plastic deformation and residual stresses in metal surfaces were investigated for metals finished with metal cutting and abrasive grinding tools. The depth and spread of stress, and the influences of lubricants and tool material and wear are described. N.E.N.

N70-42609 National Lending Library for Science and Technology, Boston Spa (England).
CONDITIONS FOR OBTAINING HIGH-STRENGTH REFRACTORY COATINGS BY SPRAYING IN A LOW-TEMPERATURE PLASMA JET [USLOVIYA NOLUCHENIYA VYSOKOPROCHNYKH TUGOPLAVKIKH POKRYTIII METODOM NAPYLENIYA V STRUE NIZKOTEMPERATURNOI PLAZMY]
V. A. Gladkovskii Jun. 1970 5 p refs Transl. into ENGLISH from Fiz. i Khim. Obrabot. Mat. (USSR), no. 3, 1968 p 147–148
(NLL-RTS-5788) Avail: Natl. Lending Library, Boston Spa, Engl.: 8s; 1 NLL photocopy coupon

The conditions for spraying powdered tungsten or aluminum oxide are described for obtaining coatings for protection against high temperatures, high voltages, and strong chemicals. Carbon steel or titanium pieces are sand blasted and treated with a sublayer of chrome-nickel steel before spraying. The critical parameters are considered to be arc voltage, current, distance from nozzle, velocity of emission, and magnitude of arc gap. The physical properties of the refractory coatings are tabulated. N.E.N.

N70-42684# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROTARY-ACTION BROACHES

P. S. Chistoserdov 28 May 1970 11 p refs Transl. into ENGLISH from Mashinostroitel (Moscow), no. 12, 1968 p 20–22
(AD-710265; FTD-HT-23-289-70) Avail: NTIS CSCL 13/9

The productivity of a rotary broach is 30-50 times as high as the productivity of ball burnishing tools and 5-10 times as high as the productivity of roller burnishing tools. The operating principle of the rotary broach is as follows: guide bar, freely carrying separator in which full-contact rollers of a given diameter are mounted at a certain angle and is inserted in a workpiece. After translational motion is communicated to the guide bar via supporting bearing, the rollers become wedged in (owing to the difference in the aperture diameters between the workpiece and the broach) and begin to roll over the surface to be machined (burnished), leaving on it helical tracks; the width of the track equals the length of the roller and the pitch of the spiral corresponds to the angle of adjustment of the roller with respect to the axis of the workpiece. The rollers cause the guide bar to rotate and move along its axis. The separator with the rollers also is endowed with rotational motion. Author (TAB)

N70-42746# Bureau of Mines, Minneapolis, Minn. Office of Mineral Resources.
IMPACT OF TECHNOLOGY ON THE COMMERCIAL SECONDARY ALUMINUM INDUSTRY
Donald L. Siebert 1970 81 p refs
(BM-IC-8445) Avail: SOD $0.75

A profile of the commercial secondary aluminum industry examines the elements that form the industry and the technological contributions of each toward industrial growth. Concise descriptions of processing methods trace aluminum scrap from generating sources to marketable industrial and consumer goods. Economic and marketing appraisals are used to illustrate the impact that recent technology has had upon the secondary aluminum industry. Price, supply, demand, competition, and substitutes are selected as components of an economic model of the secondary industry and are used to illustrate the aggregate effects of technological changes. The final section is a conceptual look at the future in which sensitive economic indicators (such as die casting in the automotive and appliance industries) are examined as well as the problems of conserving mineral resources by retrieving secondary aluminum from solid waste. Author

N70-42835# Naval Research Lab., Washington, D.C. Inorganic Chemistry Branch.
WELDING OF CERAMICS Final Report
Roy W. Rice 6 Jul. 1970 40 p refs
(AD-710359; NRL-7085) Avail: NTIS CSCL 13/8

All known work on the welding of refractory ceramics is reviewed and summarized. Oxides, carbides, and borides, as well as graphite, have been welded to themselves or to some metals (usually refractory metals) by either solid-state or fusion welding, or both. Of the two techniques employed, solid-state, or diffusion, welding is conducted below the melting point where sintering, diffusion, and/or reaction phenomena lead to bonding. This is generally done by means of pressure applied across the joint, and often with a fine powder in the seam. This technique will generally give the finest weld grain size, and hence higher strengths (e.g., 50,000 psi or more in Al_2O_3). But the total elimination of porosity can be very difficult and thus limit the use of this technique for applications in which a fraction to a few percent porosity is detrimental (e.g., to optical transmission properties). On the other hand, fusion welding is accomplished by the solidification of molten edges of the parent material or of a filler using electron-beam, optical (laser or arc-image furnaces), arc (for conductors like most carbides and borides), and flame torches, as with metals. This gives moderate (20,000-30,000 psi in Al_2O_3) to good (40,000-60,000 psi in some carbides and borides) weld strengths and is potentially the most economical welding method for many purposes. Other relative limitations and merits of diffusion and fusion welding are discussed along with some of the work needed to apply this technology on a broader scale. Author (TAB)

N70-42918# Defense Documentation Center, Alexandria, Va.
SPOT WELDING, VOLUME 1 Report Bibliography, Dec. 1956–Mar. 1968
Aug. 1970 85 p refs
(AD-710450; DDC-TAS-70-60-1) Avail: NTIS CSCL 13/8

The bibliography is a compilation of annotated references on spot welding. Computer-generated indexes for corporate author-monitoring agency, subject, personal author, and contract are included. Author (TAB)

N70-42932*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF ULTRASONIC SCANNING SYSTEM FOR IN-PLACE INSPECTION OF BRAZED TUBE JOINTS
J. L. Haynes, C. G. Wages, and H. S. Haralson 14 Sep. 1970 34 p Prepared by Spaco Inc.
(Contract NAS8-20081)
(NASA-TM-X-64558) Avail: NTIS CSCL 13H

The developed scan system is capable of scanning brazed tube joints, with limited clearance access, in 1/4 through 5/8 inch union, tee, elbow, and cross configurations. The average test time for a particular tube size and configuration, after a 30 minute setup sequence, is 3 to 4 minutes. The system is capable of detecting brazing defects as small as 0.008 by 0.010 inch which exceeds the 0.015 inch diameter defect resolution required by specification. The ultrasonic brazed tube scanner is recommended for any required evaluation of brazed tube joints which are within the scanner's dimensional capabilities. This recommendation is based upon the rapid inspection time and the capability of the basic ultrasonic method to detect defective conditions not associated with material density changes in addition to those which are dependent upon density variations. Author

N70-42995*# National Aeronautics and Space Administration, Washington, D.C.
MATERIALS TECHNOLOGY: INTRODUCTION AND OVERVIEW
G. C. Deutsch *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 239–245 (See N70-42976 24-30)
Avail: NTIS CSCL 13K

The advanced materials problems and technology pertinent to the space shuttle are briefly reviewed. The major topics are high temperature metals; structural composite materials; materials environmental compatibility; bearings, lubricants, and seals; design properties of materials; and advanced inspection and repair techniques for materials. N.E.N.

N70-42999*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
BEARING, LUBRICANTS, AND SEALS FOR THE SPACE SHUTTLE
Harold E. Sliney *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 289–296 (See N70-42976 24-30)
Avail: NTIS CSCL 13K

The unique mission requirements of the space shuttle will expose some of the bearings, lubricants, and seals to extreme conditions of temperature and pressure. Three major problem areas are considered: lubrication and design of airframe control surface bearings, thermally-stable fluids for hydraulics and for jet engine lubrication, and shaft seals for liquid hydrogen pumps. Author

N70-43036 Texas Univ., Austin.
WHIRL OF SHAFT-ROTOR SYSTEMS SUPPORTED BY BALL BEARINGS
Harald Portig (Ph.D. Thesis) 1969 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-21875

Two numerical methods are developed that allow the determination of the whirl characteristics of rotors running on shafts supported by ball bearings. The shafts are considered massless. Their masses are considered to be bulked at the rotor positions. In both approaches every rotor or bearing is separated from another rotor or bearing by a shaft segment. Both methods take into account the internal deflections of balls and races of the bearings. Major assumptions include: massless bearing balls, no friction between balls and races, no forces due to ball separators, and the balls are evenly spaced around the bearings. To check the validity of the analyses, experiments were performed, the results of which were directly comparable to those of the MIMIC simulation. Solutions from the iterative and simulation approaches were then compared for cases where both applied. Dissert. Abstr.

N70-43050# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
THE USE OF THE RING COMPRESSION TEST FOR DEFINING REALISTIC METAL PROCESSING PARAMETERS Technical Report, Jan. – May 1970
Alan T. Male and Vincent de Pierre Jun. 1970 36 p refs
(Contract F33615-69-C-1198)
(AD-710591; AFML-TR-70-129) Avail: NTIS CSCL 13/8

The ring has been shown to be a very versatile tool for studying realistic metalworking processing parameters. Computer solutions of mathematical analyses made of ring compression have been verified by experimental tests, have increased the accuracy of the original purpose of the ring test for determining quantitative friction measurements under processing conditions and have provided a method for optimizing the geometry for friction studies. The solutions have also been applied to the determination of true stress-true strain compression curves for deforming materials under processing conditions. These curves provide flow strength data required for computing deformation loads in metalworking operations and serve as a reference base for metalworking workability studies. Author (TAB)

N70-43142*# Aerojet Liquid Rocket Co., Sacramento, Calif.
LOW COST TURBOPUMP STUDY Final Report, 30 Jun. 1969 – 13 Feb. 1970
M. W. Young 17 Jul. 1970 496 p refs
(Contract NAS8-24859)
(NASA-CR-110901; ALRC-2100-4) Avail: NTIS CSCL 13K

The design and development of low cost turbine pumps and applications to specific missions are discussed. The optimal conceptual design of a selected turbine pump configuration and the preliminary planning for the development, production, and acceptance of the pump are reported. It is concluded that relaxation of design requirements is not the manner by which to reduce costs. Turbine pump costs can be reduced by as much as 40 percent by stricter design requirements which will permit elimination of acceptance test operations. Author

N70-43147 National Lending Library for Science and Technology, Boston Spa (England).
PUMPS FOR LIQUID METALS
A. A. Rineiskii et al 14 May 1970 46 p refs Transl. into ENGLISH from Russian Rept. Presented at IAEA Symp. on Progr. in Sodium-Cooled Fast Reactor Eng., Monaco, 23 – 27 Mar. 1970
(NLL-RISLEY-Trans-1935-(9091.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

The basic requirements for reactor installations and the working conditions of pumps in reactor loops are examined. Constructional features, types and appropriate fields for the application of mechanical and electromagnetic pumps are discussed, and some data are given on the pumps used on Soviet fast reactors. The experience gained in 10 years of operation of the BR-5 reactor electric pumps is examined. A study of hydrostatic bearings designed to work in sodium is discussed. Author

N70-43176 National Lending Library for Science and Technology, Boston Spa (England).
ANALYSIS OF THE KINEMATIC ACCURACY OF GEAR AND THREAD CUTTING MACHINES [ANALIZ KINEMATICHESKOI TOCHNOSTI ZUBO I REZBOOBRATYVAYUSHCHIKH STANKOV]
A. I. Pluzhnikov et al Jul. 1970 24 p refs Transl. into ENGLISH from Tr. Univ. Druzhby Narod. Im. Patrisa Lumumby (USSR), v. 16, 1966 p 13 – 39
(NLL-RTS-5725) Avail: Natl. Lending Library, Boston Spa, Engl.: 8 NLL photocopy coupons

A method of analyzing the kinematic accuracy at the design stage of a machine tool is described, and the kinematic structure of the accuracy systems in gear and thread cutting machines is examined. It is concluded that the calculations make it possible to determine the expected degree of accuracy of the machine and product and to analyze the accuracy balance of them. The distinction between errors of the tool and blank makes it possible to determine the errors which designers wish to know and which can be controlled. N.E.N.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N70-41806*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PROPOSAL FOR THE COHERENT PROPAGATION STUDIES PORTION OF THE 10.6-MICROMETER LASER COMMUNICATIONS EXPERIMENT ADVANCED TECHNOLOGY SATELLITE-F TECHNICAL PROPOSAL
Nelson McAvoy, Peter O. Minott, Robert S. Lawrence (ESSA), and Gerard R. Ochs (ESSA) Jun. 1970 49 p refs Submitted for publication
(NASA-TM-X-65359; X-524-70-377) Avail: NTIS CSCL 20E

It is proposed that the propagation experiment be performed from two separate ground stations, each with its own co-investigator, one station to be located at Goldstone, California, and the other at Greenbelt, Maryland. The experiment objectives, measurements to be made, equipment, and plan are described for each ground station. Measurements are suggested to allow comparison of the effects of atmospheric turbulence on the space-to-earth 10.6 micrometer beam with conventional ground-based observations predicting communication channel quality. P.A.B.

N70-42089# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
DEVELOPMENT OF A LASER SYSTEM FOR ABSOLUTE ATMOSPHERIC DIFFUSION MEASUREMENT OF A GASEOUS TRACER MATERIAL Final Report, Jan. 1967 – Jun. 1969
Walt Vail, Todd Gilmore, and Richard L. Gordon Dec. 1969 42 p refs
(AD-709248; BNW-139; AFCRL-70-0258) Avail: NTIS CSCL 20/5

Results are reported of experiments designed to identify a gaseous tracer material for use in a laser system for real-time observation of atmospheric diffusion. Three possible mechanisms of interaction between light and gas molecules are discussed: resonance scattering, Rayleigh scattering, and fluorescence. Wavelength requirements connected with the resonance scattering approach require additional laser development. Successful application of the Rayleigh scattering technique awaits identification of a gas with a Rayleigh scattering cross section near 10 to the -21st power cm. squared. The fluorescence approach is feasible at this time with hexafluoroacetone as the tracer gas and a nitrogen laser as the light source. Preliminary system design considerations are presented in an appendix. Author (TAB)

N70-42094*# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
OPTICAL SYNCHRONIZATION-PHASE LOCKING WITH SHOT NOISE PROCESSES Interim Technical Report
R. Gagliardi and M. Haney Aug. 1970 73 p refs
(Grant NGR-05-018-104)
(NASA-CR-114115; USCEE-396) Avail: NTIS CSCL 20E

The results are presented of a study effort examining time synchronization in an optical communication system. Consideration is given primarily to time locking by means of a phase lock tracking loop. Since photodetection of an intensity modulated optical beam produces a shot noise random process at its output, synchronization analysis requires a study of phase locking with shot noise processes. A statistical analysis of tracking shot noise is presented. Of particular interest is the probability density of the tracking error, which indicates the behavior of the loop during tracking, and therefore is directly related to the ability to maintain accurate synchronization. The results of the study also have application to ranging and Doppler tracking using optical systems. Author

N70-42097*# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
COMMUNICATION THEORY FOR THE FREE SPACE OPTICAL CHANNEL Interim Technical Report
R. Gagliardi, S. Karp, and E. O'Neill Aug. 1970 61 p refs
(Grant NGR-05-018-104)
(NASA-CR-114116; USCEE-397) Avail: NTIS CSCL 20E

Discussions are given on quantum detectors, the noise mechanisms basic to their operation, and the application to optical communication theory. Channels are considered in which the electromagnetic field is not subjected to any propagation effects other than a geometric loss. Optimum time processing using the tools of statistical communication theory is emphasized. The quantum detector output electron number is established as a conditional Poisson process with the conditioning variable being the modulus of the electromagnetic field. The current flow is analyzed as a shot noise process and the power density spectrum is calculated. Analog communication is presented primarily in terms of the signal to noise ratio. The S/N ratio in direct detection is given both as a ratio of the integrals of two separate portions of the spectrum and as a ratio of two moments of the probability density describing the current. Digital communication is discussed in the context of detection theory. It is shown that the likelihood ratio is often a monotonic function of the random variable representing the number of electrons flowing. Digital design is presented in terms of M-ary signalling, error probabilities, and information rates. Author

N70-42139*# General Telephone and Electronics Labs., Inc., Bayside, N.Y. Research Center.
INVESTIGATION OF ELECTRO-OPTICAL TECHNIQUES FOR CONTROLLING THE DIRECTION OF A LASER BEAM Final Report
A. Hanna, J. Schlafer, S. Reich, and V. J. Fowler 30 Jun. 1970 85 p refs
(Contract NAS8-11459)
(NASA-CR-102881; TR-70-722.72) Avail: NTIS CSCL 20E

Precision laser beam deflectors employing piezoelectrically driven mirrors were investigated for applications in optical and infrared tracking systems. Two types, the shear plate mirror deflector and the bender-bimorph mirror deflector were examined for maximum attainable resolution, frequency response, hysteresis, thermal and aging effects, and for unwanted modes of operation. Design curves were developed for predicting deflector characteristics and deflection sensing schemes were investigated. The piezoelectric bender-driven mirror deflector, a large-aperture, high-resolution device employing strain gage sensing elements for monitoring mirror position, is evaluated for its ability to withstand the rigors of spacecraft launching and the environment in outer space. Author

N70-42182*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LASER NET: A SYSTEM FOR MONITORING WINGTIP VORTICES ON RUNWAYS
B. H. Funk and K. D. Johnston 3 Jun. 1970 26 p refs
(NASA-TM-X-64525) Avail: NTIS CSCL 20E

A laser schlieren method is proposed which potentially provides a means for monitoring the strength of vortex wakes on and near runways. The method could provide a gross, continuous assessment of the intensity of disturbances over airport runways and aircraft carriers. Preliminary measurements behind a wingtip mounted on the wall of a small subsonic wind tunnel indicate that wingtip vortices are readily detectable with this simple system. Author

N70-42224# Systems Science and Software, La Jolla, Calif.
ENERGY DEPOSITION IN LASERS Bimonthly Technical Report, 1 May – 30 Jun. 1970
Marius Troost and C. W. Hartley 29 Jul. 1970 18 p refs
(Contract N00014-70-C-0341; ARPA Order 660)
(AD-709978; Rept-3SR-405) Avail: NTIS CSCL 20/5

A UNIVAC 1108 FORTRAN IV computer program has been written to determine the distribution of energy deposition within a LASER assembly. The code is currently running but needs further enhancement of its input and output facilities as well as a source description. The program uses ray tracing and Monte Carlo methods to obtain a solution. The geometrical and property input to the code is very simple and convenient to write, but the source input still needs to be defined. Author (TAB)

N70-42252# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
DESCRIPTION OF ATMOSPHERIC TURBULENCE FOR LINEAR PROPAGATION OF LASER BEAMS
Henry Hidalgo and Roberto Vaglio-Laurin Jul. 1970 76 p refs
(Contract DAHC15-67-C-0011)
(AD-709434; RP-P-600; IDA/HQ-70-11343) Avail: NTIS CSCL 20/5

The paper considers the fluid mechanical aspects and data relevant to the propagation of low power-density lasers in the atmospheric boundary layer. Its scope includes the following topics: (a) formulation of the role of the turbulent structure in determining phase and amplitude characteristics of received signals, with emphasis on single scattering situations, (b) review of available fluid mechanical data for mean and fluctuating flow properties for various atmospheric conditions, (c) identification of the atmospheric conditions that require complementary fluid mechanical measurements, and (d) problem areas that need further theoretical investigations concerning the effect of atmospheric turbulence on optical wave propagation. Author (TAB)

N70-42275# California Inst. of Tech., Pasadena. Quantum Electronics Lab.
MAGNETIC FIELD AND PRESSURE EFFECTS IN A SATURATED GAS LASER AMPLIFIER
Robert T. Menzies Mar. 1970 203 p refs Sponsored in part by NSF
(Grant AF-AFOSR-1492-68)
(AD-709238; AFOSR-70-1932TR; SR-11) Avail: NTIS CSCL 20/5

Theoretical and experimental studies of a gas laser amplifier are presented, assuming the amplifier is operating with a saturating optical frequency signal. The analysis is primarily concerned with the effects of the gas pressure and the presence of an axial magnetic field on the characteristics of the amplifying medium. Semi-classical radiation theory is used, along with a density matrix description of the atomic medium which relates the motion of single atoms to the macroscopic observables. A two-level description of the atom, using phenomenological source rates and decay rates, forms the basis of our analysis of the gas laser medium. Pressure effects are taken into account to a large extent through suitable choices of decay rate parameters. The behavior of a He-Ne gas laser amplifier in the presence of an axial magnetic field has been studied experimentally by measuring gain and Faraday rotation of linearly polarized resonant laser signals for various values of input signal intensity, and by measuring nonlinearity - induced anisotropy for elliptically polarized resonant laser signals of various input intensities. The experimental results agree quite well with corresponding theoretical expressions which have been developed to include the nonlinear effects of saturation strength signals.
Author (TAB)

N70-42280# Massachusetts Inst. of Tech., Cambridge. Crystal Physics Lab.
GROWTH OF THIOSPINELS INVESTIGATION OF CRYSTALS FOR CO2 HIGH POWER LASER WINDOWS
Final Report, 1 Jun. 1968 - 30 Nov. 1969
Alexander Smakula and Arthur Linz 23 Jul. 1970 51 p refs
(Contract N00014-67-A-0204-0025; ARPA Order 306)
(AD-709988; TR-15) Avail: NTIS CSCL 20/5

The report deals with the investigation of single crystals for higher power laser windows. The following crystals were grown and their optical properties studied: KF, RbF, CsF; NaCl, KCl, RbCl; KBr, RbBr, CsBr; CsI; AgBr; CuCl; PbCl2, PbBr2; CdS, In2S3, and CdS.In2S3. The ultraviolet (or visible) and infrared absorption edges were measured. The influence of absorption maxima, temperature and impurities on the absorption edges is discussed. Comparing the absorption at 10.6 micro m with infrared absorption edges, there is an evident relation: for most crystals the absorption at 10.6 micro m decreases with increasing spectral distance from the absorption edges. RbCl has the lowest absorption of all investigated crystals. Deviation from the above relation in some crystals is correlated to crystal defects or surface contamination. The pure polyatomic semi-conductors, CdS, In2S3 and CdS.In2S3 showed two orders of magnitude higher absorption than most ionic crystals and therefore are not suitable for high power laser windows. For better windows a further improvement of crystal purity is necessary.
Author (TAB)

N70-42389*# Case Western Reserve Univ., Cleveland, Ohio. Div. of Electrical Sciences and Applied Physics.
LASER TECHNOLOGY FOR COMMUNICATIONS
Semiannual Technical Progress Report, 1 Feb. - 31 Jul. 1970
Yoh-Han Rao 31 Jul. 1970 66 p refs
(Grant NGR-36-027-014)
(NASA-CR-114117; SATPR-1) Avail: NTIS CSCL 20E

Initial results of three investigations are presented. In a Stark modulation study, 17 gases were evaluated for use in gas modulators for CO2 lasers. The most promising gas and laser line combinations are 1,1 difluoroethylene with the P(22) line of the 10.6 micron transition and methyl bromide with the P(26) line of the 9.6 micron transition. Laser performance was investigated for a space approved CO2 laser package under conditions of decreasing gas pressure, discharge current variation, cavity length changes, and electro-optic crystal modulator heat rise in the cavity. Results show that the laser may be operated without a frequency selecting unit in the cavity and the 10.6 micron lines P(18), P(18), and P(20) will oscillate provided the cavity length can be tuned over a distance of about five microns. The resolution and sensitivity of SF6 molecular spectra in the 10.6 micron region were examined using heterodyne detection and inverted Lamb dip spectroscopy. E.C.

N70-42396*# Techtran Corp., Glen Burnie, Md.
THE THEORY OF QUANTITATIVE SPECTROGRAPHIC ANALYSIS WITH A LASER EXCITATION SOURCE [K TEORII KOLICHESTVENNOGO SPEKTRALNOGO ANALIZA S LAZERNYM ISTOCHNIKOM VOZBUZHDENIYA]
N. G. Preobrazhenskiy et al Washington NASA Oct. 1970 10 p refs Transl. into ENGLISH from Zh. Prikl. Spektrosk. (USSR), v. 5, no. 6, Dec. 1966 p 706 - 711
(Contract NASw-2037)
(NASA-TT-F-13344) Avail: NTIS CSCL 20E

A luminous layer which is formed by laser heating of a sample is very inhomogeneous and distinguishes itself by considerable optical density. On these grounds it is profitable to abandon the traditional methods in which the total intensity of a spectrum line is registered and to take, as a measure of element concentration the spectral interval between two maxima of a self-reversed line. The dependence of this interval on the optical density of the radiant layer under different conditions in spectrum excitation is studied in detail.
Author

N70-42412# Defense Documentation Center, Alexandria, Va.
LASER COMMUNICATION SYSTEMS (2): A DDC BIBLIOGRAPHY, OCTOBER 1961 - AUGUST 1969
Aug. 1970 137 p refs
(AD-710460; DAC-TAS-70-56-2) Avail: NTIS CSCL 17/2

Entries in this annotated bibliography are references to unclassified and unlimited reports processed into the Defense Documentation Center's data bank from January 1953 through March 1970. Corporate author-monitoring agency, subject, personal author, contract, and report number indexes are provided.
Author (TAB)

N70-42503# European Space Research Inst., Frascati (Italy).
THE USE OF OPTICAL RADARS FOR THE DETERMINATION OF ATMOSPHERIC COMPOSITION, MOTION AND TEMPERATURE
Giorgio Fiocco Dec. 1968 31 p refs Presented at the 5th ESRO Summer School, Frascati, Italy, Aug. 1967
(ESRO-SN-81-ESRIN) Avail: NTIS

Echoes of laser light scattered by atmospheric constituents contain information related to their dimension, composition, and dynamics. Present and future applications of this technique are reviewed.
Author (ESRO)

N70-42513# Aerospace Corp., El Segundo, Calif. Lab. Operations.
INFRARED EMISSION AT 2.7 MICRONS FROM FLOWING CO 2 - N 2 MIXTURES Research Report, Jul. 1969 - Jan. 1970
Peter E. Oettinger and Kenneth P. Hom 31 Jul. 1970 23 p refs
(Contract F04701-70-C-0059)
(AD-710607; TR-0059(6220-50)-3; SAMSO-TR-70-285) Avail: NTIS CSCL 20/5

A flow tube has been constructed wherein ground-state CO2 and vibrationally excited N2 molecular streams interact and the

combined flow is spectrally investigated at selected downstream stations. The close coupling between the lower vibrational levels of N2(X singlet Sigma(g)(+)) and the CO2 asymmetric stretch mode (00 v3) allows rapid energy exchange to these levels, followed by internal redistribution among the vibrational states of the CO2 modes. In order to determine the rate of populating the mixed-mode 10 1 and 02 1 states of CO2, spectroscopic observations were made at selected locations along the flow tube of the profile of the 2.7 micron resonance radiation band corresponding to these levels. The magnitude and spectral distribution of this radiation are discussed, as well as the associated reaction rates. Author (TAB)

N70-42551# ARO, Inc., Arnold Air Force Station, Tenn.
AERODYNAMIC HOLOGRAPHY Final Report, Jul. 1967 - Jul. 1969
J. D. Trolinger and J. E. O'Hare AEDC Aug. 1970 98 p refs
(Contract F40600-71-C-0002)
(AD-709764; AEDC-TR-70-44) Avail: NTIS CSCL 20/4

A summary of the work in holography at AEDC is presented. The work includes basic and applied research with emphasis on the applications of holography to aerodynamic testing. Author (TAB)

N70-42699# Texas Univ., Austin. Electronics Research Center.
MULTI-PASS OPTICAL ATTENUATION MEASUREMENTS UTILIZING HOLOGRAPHIC TECHNIQUES AND OPTICAL LASER SCATTERING FOR ANALYSIS OF TRANSPARENT MEDIA
Otto M. Friedrich, Jr., Frederic Weigl, and Arwin A. Dougal 27 May 1970 13 p refs Presented at the 16th Natl. Symp., Analysis Instrumentation Div., Instr. Soc. of Am., Pittsburgh, 25-27 May 1970
(Grant AF-AFOSR-1792-69)
(AD-710144; AFOSR-70-2146TR) Avail: NTIS CSCL 20/5

A theory is developed and presented for multi-pass attenuation measurements using holographic recording/reconstruction techniques. The intensities of the first-order reconstructed beams are shown to vary directly with the intensity of the desired multi-pass test beam component under proper conditions. An improved holographic reconstruction of an attenuating transparent medium is proposed which incorporates the use of a low resolution positive print of the negative hologram to achieve desirable film fog cancellation. A theory has been formulated for this improved, proposed holographic reconstruction technique where enhanced image results are predicted. Author (TAB)

N70-42768# Rheinisch-Westfalische Technische Hochschule, Aachen (West Germany). Inst. fuer Halbleitertechnik.
INVESTIGATION OF A TECHNOLOGICAL PROCEDURE FOR THE FABRICATION OF LASER DIODES [UNTERSUCHUNG EINES TECHNOLOGISCHEN VERFAHRENS ZUR HERSTELLUNG VON LASERDIODEN]
H. Beneking and W. Vits Jun. 1970 81 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-34) Avail: NTIS; ZLDI Munich: 16,60 DM

The fabrication of gallium arsenide laser diodes by liquid phase epitaxy is described using phase diagrams. The epitaxy apparatus and process and the preparation of laser diodes are also described. The quality of the epitaxial layers and the planarity of the p-n junctions are shown to depend on substrate orientation and process parameters. The doping profiles and the optical and electrical properties of the diodes are discussed. Author (ESRO)

N70-43099# John Carroll Univ., Cleveland, Ohio. Dept. of Physics.
STUDIES OF INTERACTIONS OF LASER RADIATION WITH SOLIDS AND LIQUIDS Final Report, 1 Dec. 1965 - 28 Feb. 1970
Edward F. Carome 16 Jul. 1970 10 p refs
(Contract DA-31-124-ARO(D)-424)
(AD-710279; AROD-6285-5-P) Avail: NTIS CSCL 7/4

The report covers a project which has included the investigation of such effects as dielectric breakdown, impulse heating, and the generation of intense pressure pulses by focused pulsed ruby laser beams; stimulated Brillouin scattering of pulsed ruby laser light; and ordinary Brillouin scattering of low power continuous He-Ne laser light. During the final stages of the contract emphasis has been placed on effects observable by ordinary Brillouin scattering. This latter work is an outgrowth of the emerging interest in the scattering of laser light by pure fluids and mixtures near critical points. Author (TAB)

N70-43182# Aeronautical Research Labs., Melbourne (Australia).
CONSIDERATION OF ACOUSTIC HOLOGRAPHY FOR NONDESTRUCTIVE TESTING APPLICATIONS
A. J. Farrell Jan. 1970 67 p refs
(ARL/I-72) Avail: NTIS

Application of the principles of acoustic holography to the field of non-destructive testing of materials is examined. Acoustic holographic principles are reviewed and the various methods of acoustic wave visualization are critically compared. A visualization technique for experimental purposes is recommended. It is concluded that acoustic holography could be a useful addition to existing nondestructive testing techniques. A sequence of experimental steps to prove this conclusion is outlined. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N70-41900# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
TENSILE PROPERTIES OF IRRADIATED INCONEL 718 AND INCONEL X750 AT CRYOGENIC TEMPERATURE
R. P. Shogan Aug. 1969 38 p refs
(WANL-TME-1922) Avail: NTIS

Inconel 718 and Inconel X750 parent and welded sheet and Inconel 718 brazed sheet were irradiated in GTR-19 (WANL Irradiation Test 37/W405) and tested at temperatures from 140 to 2000 R. Inconel 718 sheet exhibited reductions in elongation at 140 and 1500 R while welded sheet and brazed specimens showed no change in properties after the irradiation. The ultimate tensile strength was not affected but the yield and notched tensile strengths of Inconel X750 parent and welded specimens increased at 140 and 540 R. These effects were removed after a one hour anneal at 1000 R. The elongation of the Inconel X750 sheet decreased at 140 R and at the elevated test temperatures. Author (NSA)

N70-41933# Boeing Co., Renton, Wash. Commercial Airplane Group.
EFFECT OF EXPOSURE TIME AT 250 F ON STRESS-CORROSION CRACK GROWTH RATES IN 2024-T351 ALUMINUM Research Report
Michael V. Hyatt and William E. Quist Mar. 1970 20 p refs
(Contract N00014-66-C-0365; ARPA Order 878)
(AD-709573; D6-25218) Avail: NTIS CSCL 11/6

The sensitization of 2024-T351 to stress-corrosion cracking after exposure at 250 F has been measured using precracked double cantilever beam (DCB) specimens taken in the short-transverse grain direction from 1-in.-thick plate. The susceptibility of the material was assessed by measuring stress-corrosion crack growth rates as a function of the plane-strain stress intensity K(I) in specimens periodically wetted with a 3.5% NaCl solution. Author (TAB)

N70-41935# Boeing Co., Renton, Wash. Commercial Airplane Group.
OBSERVATIONS ON THE STRESS-CORROSION CRACK PROPAGATION CHARACTERISTICS OF HIGH-STRENGTH STEELS
Clive S. Carter May 1970 23 p refs
(Contract N00014-66-C-0365; ARPA Order 878)
(AD-709574; D6-25274) Avail: NTIS CSCL 11/6

The relationship between stress-corrosion crack velocity and crack-tip stress intensity is discussed. In most high-strength steels there is a wide range of stress intensity over which crack velocity is essentially constant. Methods of estimating this velocity are described. Values for a variety of high-strength steels are presented and the effects of metallurgical variables are indicated. Implications with regard to testing procedure, crack morphology, and service performance are outlined. Author (TAB)

N70-41944*# Dynatech Corp., Cambridge, Mass.
AN EXPERIMENTAL INVESTIGATION OF THE THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF THREE POROUS 304L STAINLESS STEEL 'RIGIMESH' MATERIALS TO 1300 K Interim Report
R. P. Tye 27 Aug. 1970 24 p refs
(Contract NAS3-12012)
(NASA-CR-72710) Avail: NTIS CSCL 11F

Measurements of the thermal conductivity of a Rigimesh stainless steel in three different porosities were undertaken in vacuum and in a nitrogen atmosphere over the temperature range 300 to 1300 K by the comparative method with the heat flow perpendicular to the surfaces of the sample. Electrical resistivity measurements were undertaken in two mutually perpendicular directions on separate samples of the same material. The results indicate that, although there is a threefold increase in thermal conductivity when the porosity decreases from approximately 40 to 10% and a corresponding decrease in electrical resistivity for the same current and heat flow directions, the value of the derived Lorentz function remains constant to within 8%. Author

N70-41962 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATION INTO HARDENING AND RESIDUAL STRESSES IN FACE MILLING OF HEAT-RESISTANT AND TITANIUM ALLOYS [ISSLEDOVANIE NAKLEPA I OSTATOCHNYKH NAPRYAZHENII PRI TORTSOVOM FREZEROVANII ZHAROPROCHNYKH I TITANOVYKH SPLAVOV]
K. F. Mitryaev Jul. 1970 11 p refs Transl. into ENGLISH from Vysokopraizvoditelnoo Rezanie v Mashinostr. (Moscow), 1966 p 255 – 262
(NLL-RTS-5814) Avail: Natl. Lending Library, Boston Spa, Engl.: 1£ 4s CSCL 11/6

The results of investigations into the hardening and first-order residual stresses during face milling of titanium alloys VT6 and OT4, a nickel-base heat-resistant alloy, and a steel are given. The physical-mechanical properties of the materials at 20 C are presented. In face milling low ductility titanium alloys, hardening on the work surface and tool surface is slight. The degree of hardening ranges from 8 to 20% and the depth of hardening from 50 to 150 microns. Compressive residual stresses reaching a value of -70 to -90 kg/sq mm are formed on the work surface. In working ductile materials, the hardening is considerably greater; 20 to 50% and 150 to 400 microns respectively, and tensile stresses form on the work surface. Control of the amount of hardening and residual stressing can be achieved within certain limits through the cutting speed, feed, rake angle, side rake angle of the cutting edge, and the main angle in plan. Machining components with a worn tool, and the use of low feeds contribute to a considerable increase in hardening and compressive residual stresses. Author

N70-41981*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VAPORIZATION OF CHROMIUM OXIDES FROM THE SURFACE OF T D Ni Cr UNDER OXIDIZING CONDITIONS
Fred J. Kohl and Carl A. Stearns Aug. 1970 31 p refs
(NASA-TM-X-52879) Avail: NTIS CSCL 11F

Thermodynamic calculations and experimental mass spectrometric studies were made in an effort to elucidate the mode and rate of oxidative vaporization of the thoria-dispersed Nickel-20 percent chromium alloy. With thermodynamic data from the literature, vapor pressures for CrO3(g), CrO2(g), CrO(g) and Cr(g) were calculated for the equilibrium vaporization of Cr2O3(s) over the temperature range from 900 to 1800 K at oxygen pressures from 1 to 10 to the minus 12th power atmospheres. The rate of weight loss of Cr from unit surface area per second was calculated as a function of temperature and oxygen pressure and the results are presented graphically. Methods of making other calculations for engineering applications are also given. The enhanced volatility of Cr2O3(s) in the presence of water vapor was considered. Calculation of the vapor pressures of CrO2(OH)(gas) were made as a function of temperature, oxygen pressure and water vapor pressure. The results of these calculations are presented in graphical form. Author

N70-42039*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HYDROGEN HALIDE CLEANING OF NICKEL-20 CHROMIUM CONTAINING DISPERSED THORIA
Thomas P. Herbell Sep. 1970 23 p refs
(NASA-TM-X-52887) Avail: NTIS CSCL 11F

The Cr2O3 content of powder metallurgy nickel-20 chromium-3 thoria was reduced with atmospheres consisting of hydrogen plus hydrogen chloride or hydrogen bromide. The non-thoria oxygen content or oxygen excess was reduced from an initial amount of greater than 50,000 ppm to less than 100 ppm. Low temperatures were effective, but the lowest oxygen levels were achieved with the highest cleaning temperature, 1200 C. Author

N70-42045*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LONG TIME CREEP BEHAVIOR OF TANTALUM-10 TUNGSTEN IN HIGH VACUUM
Robert H. Titran and William D. Klopp Washington Oct. 1970 22 p refs
(NASA-TN-D-6044) Avail: NTIS CSCL 11F

The high vacuum creep behavior of tantalum - 10 tungsten in the 2000 to 2600 F (1093 to 1426 C) range was studied for times up to 10,000 hours. The creep strength was found to be related to grain size, the secondary creep rate increasing with decreasing grain size. The exponential factor n relating creep rate to applied stress was found to increase with increasing grain diameter. Analysis of the creep curves showed that after an initial period of decreasing creep rate, the creep rate gradually increased with time. Creep strain during the nonlinear second-stage creep was proportional to time to the 1.5 power. Author

N70-42175*# Hughes Aircraft Co., Los Angeles, Calif. Space Systems Div.
EXPERIMENTAL LIQUID METAL SLIP RING PROJECT Final Report

R. B. Clark 22 Jun. 189 p refs
(Contract NAS3-11537)
(NASA-CR-17180) Avail: NTIS CSCL 11F

Slip rings employing liquid gallium to transfer electrical power across rotating joints were experimentally studied with respect to application in satellites. Candidate materials for electrodes, insulators, and barrier films were tested. A ten ring assembly was operated in high vacuum for 60 days carrying 100 A. Data from electrical, physical, chemical, and visual examination are presented. Contact resistance was less than one microhm per sq cm for nickel-plated electrodes wetted with gallium. Surface film on the gallium caused debris during rotation. Gallium was retained in the rings by surface tension. Author

N70-42267*# Scientific Translation Service, Santa Barbara, Calif.
ON THE VERY HIGH PURIFICATION OF IRON BY THE 'MELTED ZONE' METHOD [SUR LA PURIFICATION TRES POUSSEE DU FER PAR LA METHODE DE LA 'ZONE FONDUE']
Jean Talbot et al Washington NASA Sep. 1970 6 p refs Transl. into ENGLISH from Compt. Rend. (Paris), v. 244, no. 12, 1957 p 1577–1579
(Contract NASw-2035)
(NASA-TT-F-13249(Avail: NTIS CSCL 11F

Research on the properties of iron was conducted by the melted zone method of purification. Significant purification for a great number of elements was obtained. Author

N70-42308# Army Weapons Command, Rock Island, Ill. Science and Technology Lab.
IONITRIFICATION KINETICS OF TWO COMMERCIAL STEELS
William D. Soccorsy and William T. Ebihara Jun. 1970 23 p refs
(AD-709582; AMSWE-RE-70-156) Avail: NTIS CSCL 13/8

The penetration of nitrogen into two commercial steels (Nitralloy 135M and AISI 4140) was studied under glow-discharge conditions. Comparisons are made with those steels conventionally nitrided. With the use of identical conditions of temperature and time, the depth of penetration was observed to be consistently higher for ion-nitrided samples than for gas-nitrided samples. Further, the thickness of the white layer (Fe4N) is substantially less for ion-nitrided specimens than for those specimens commercially nitrided. The dual role of hydrogen ions in cleansing the work surface and in inhibiting the growth of the surface-layer nitrides was established. Author (TAB)

N70-42489 California Univ., Berkeley.
THE FATIGUE OF ALUMINUM ALLOYS SUBJECTED TO RANDOM LOADINGS
Roy Ikegami (Ph.D. Thesis) 1969 202 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-18936

A method is presented for predicting the fatigue life of unnotched aluminum alloy structures which are subjected to either constant amplitude sinusoidal or narrow band random fatigue loadings. The accumulation of damage due to cyclic loadings is formulated in terms of the propagation of a fatigue crack so that the fatigue life of the structure can be determined from a crack growth model. A crack growth model is developed and applied to the problem of predicting the fatigue life of a cantilever beam specimen which is subjected to either a constant amplitude sinusoidal or a narrow band random base excitation. Only the fundamental resonance of the cantilever beam is excited. The statistical and empirical parameters required to predict fatigue lives are defined. A PDP-7 digital computer is programmed to perform time series analyses of the random test signals in order to determine the required statistical parameters. Dissert. Abstr.

N70-42559# Battelle Inst., Frankfurt am Main (West Germany).
FORMATION OF IRON(II) CHLORIDE AND IRON(III) CHLORIDE AT HIGH-TEMPERATURE CORROSION IN FURNACES
R. Rasch *In its* Battelle Inform. No. 5 Aug. 1969 p 18–22 refs (See N70-42557 24-34)
Avail: NTIS

High-temperature corrosion is initiated by decomposition of the oxide film protecting the metal, after which the hydrogen chloride contained in the furnace gases may react with FeO, Fe3C and Fe, to give volatile iron chlorides. The hydrogen chloride present in flue gases of refuse incinerators is produced by the combustion of polyvinyl chloride. ESRO

N70-42566# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
SOME EFFECTS PRODUCED BY ADDING RHENIUM TO ALLOYS OF TUNGSTEN AND CARBON Final Report, 30 Jun. 1964–31 Aug. 1969
W. S. Owen 1970 6 p
(Contract DA-31-124-ARO(D)-228)
(AD-710275; AROD-4917-5-MC) Avail: NTIS CSCL 11/6

One aspect of the rhenium alloying effect in tungsten which has not been explored quantitatively to the extent which its potential importance warrants is the change in the jump frequency of an interstitial carbon atom in a tungsten lattice. The work was designed to study this phenomenon from two aspects; the effect of rhenium on the diffusivity of carbon in tungsten and the effect on an anelastic relaxation dependent upon the jumping of carbon in a stressed tungsten lattice. Author (TAB)

N70-42651# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
CORROSION AND POLARIZATION STUDIES OF Fe-Ni BINARY ALLOYS IN SULFURIC ACID SOLUTION AT 25C
Dale O. Condit May 1970 56 p refs
(AD-709881; ARL-70-0082) Avail: NTIS CSCL 11/6

The corrosion behavior of the Fe-Ni binary system, which is a base system for the stainless steels, was investigated using potentiodynamic polarization techniques. Both anodic and cathodic potential-current scans were conducted on ten high-purity Fe-Ni alloys. Several tests were conducted on each alloy to assure reliability of the data. Some of the data were analyzed using regression analysis to determine the kinetics involved in the anodic and cathodic processes. The anodic data indicate that active dissolution of Fe-Ni alloys is controlled by Fe in alloys containing up to and including 50 atomic per cent Ni. The cathodic data suggest that the evolution of hydrogen occurs by the formation of single atoms of hydrogen which coalesce to form the diatomic gas. Furthermore, as with anodic dissolution, the kinetics of the hydrogen reaction were found to nearly the same for high Ni alloys. The data from these experiments will provide a basis for determining the effect of (cl(-)) concentration on the corrosion behavior of Fe-Ni alloys, with specific interest in solving the stress corrosion problems in these alloys and in the stainless steels. Author (TAB)

N70-42668 National Lending Library for Science and Technology, Boston Spa (England).
ON THE MACHINABILITY OF ALUMINIUM ALLOYS
H. Zoller et al 29 May 1970 20 p refs Transl. into ENGLISH from Aluminium (Dusseldorf), v. 45, no. 1, 1969 p 49–54
(NLL-M-9133-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The effects of chip temperature and chip-breaking additives were investigated to improve the machinability of aluminum alloys. Tests were carried out on a stable, vibration free frontal lathe, and Decoltal-500 (AlCu5PbBi) and Anticorodal-Pb (AlMgSi 1 Pb) were

machined. It is concluded that machinability can be improved by lowering the melting point. This can be accomplished for alloys without Mg by a suitable combination of Pb, Bi, Cd, and possibly In. Addition of the proper amount of Cd to the AlCu5PbBi alloy reduces the melting point from 130 to 95 C. In alloys containing Mg a combination of Pb and Cd is more effective. N.E.N.

N70-42685# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NAPHTHENATE SOAP AS A CORROSION INHIBITOR
N. S. Novoshinskaya et al 28 May 1970 12 p refs Transl. into ENGLISH from Izv. Vyssh. Uchbe. Zaved., Khim. i Khim. Tekhn (Moscow), v. 12, no. 6, 1969 p 831–834
(AD-710266; FTD-HT-23-236-70) Avail: NTIS CSCL 11/6

At 20 to 50 degrees, the corrosion rate of steel-3 in distilled water is reduced from 0.8-2 to 0.06 g/sq cm a day by the addition of 2.5 g naphthenate soap/1. In domestic water, the concentration of the soap required for similar corrosion inhibition approximately 11 g/1. Napthenate soap appears to function by providing a hydrophobic film on the surface of the metal by a chemosorptive action. This is shown by progressive change in the potential of the steel surface with time of exposure to the inhibitor. TAB

N70-42687# Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Materials Science.
INFLUENCE OF SURFACE CONDITION ON MECHANICAL BEHAVIOR OF HIGH STRENGTH STEEL CASTINGS Final Report
C. S. Kortovich, S. Tager, and J. F. Wallace Dec. 1969 52 p refs
(Contract DAAG46-68-C-0053)
(AD-710268; AMMRC-CR-70-07) Avail: NTIS CSCL 11/6

The research investigated the effect of mold coatings and investment casting on the surface quality of high strength cast steel. Mold coatings were evaluated to determine their effect on surface quality and roughness by light metallographic and electron microprobe analysis. Author (TAB)

N70-42689# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POWDERED-METAL MATERIALS AND PRODUCTS
N. F. Vyaznikov et al 28 May 1970 291 p refs Transl. into ENGLISH of the book "Metallokeramicheskiye Materialy i Izdeliya" 1967 p 1–224
(AD-710272; FTD-HC-23-391-69) Avail: NTIS CSCL 11/6

The book reviews methods of fabricating powder metallurgy materials and products made of iron powders or nonferrous metals, and describes their properties and use. Present theory and practices or compacting and sintering powder products under various production conditions are discussed. The most frequently used in machine-building materials and products with specific mechanical, technological and physicochemical properties are discussed at length, among them friction materials, antifriction materials, hard, heat-resistant alloys, sintered parts and tools made of high-strength compacted metals, permanent magnets and high-porosity products of various types. Author (TAB)

N70-42692# Battelle Inst., Frankfurt am Main (West Germany).
METALLURGICAL FACTORS GOVERNING THE DEVELOPMENT OF HIGH-TEMPERATURE MATERIALS
Paul Esslinger and Heinrich Winter *In its* Battelle Inform. No.2 Sep. 1968 p 4–18 refs (See N70-42691 24-34)
Avail: NTIS

Methods of increasing the strength of high-temperature materials by grain-size reduction and strain, solid solution, transformation, age, precipitation, dispersion and order-disorder transformation hardening are described. The properties of high-melting metals, nickel superalloys, single crystals, titanium-aluminium-niobium alloys and rapidly-solidified aluminium alloys are also discussed. ESRO

N70-42721# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE HIGH TEMPERATURE COMPATIBILITY OF PROMETHIUM SESQUIOXIDE
H. T. Fullam Jun. 1970 72 p refs
(Contract AT(45-1)-1830)
(BNWL-1389) Avail: NTIS

The long-term compatibility of Pm2O3 with nine different metals was evaluated at 1100 C. The metals tested were 304L SS, Hastelloy X, Haynes 25, tantalum, rhenium, tungsten, Ta–10% W, W–25% Re, and TZM. The tests lasted up to 2 yr. Sm2O3 was used as a stand-in in most of the tests. However, enough tests were run with Pm2O3 to verify that the results obtained with Sm2O3 were applicable to Pm2O3. The data obtained in the tests show that oxide compatibility at 1100 C is primarily dependent on oxide purity, and that a variety of metals can be used to contain Pm2O3 at 1100 C provided the critical impurities (i.e., H2O, C, organics) are removed from the oxide prior to use. Rhenium is the most compatible containment material. Oxide-metal interaction is essentially independent of time at temperature. Sm2O3 is a good stand-in for Pm2O3, and results obtained with Sm2O3 are completely applicable to Pm2O3. Author (NSA)

N70-42730# Technische Hochschule Hannover (West Germany) Fakultaet fuer Mathematik und Naturwissenschaften.
INVESTIGATING THE APPLICABILITY OF 2-MERCAPTO 2,4,6-CYCLOHEPTATRIEN-ON-(1) IN PHOTOMETRIC METAL ANALYSIS [UNTERSUCHUNGEN ZUER ANWENDBARKEIT VON 2-MERCAPTO-2,4,6-CYCLOHEPTATRIEN-ON-(1) IN DER PHOTOMETRISCHEN METALLANALYSE]
Adolf Kossmann (Ph.D. Thesis) 1968 153 p refs In GERMAN
Avail: NTIS

Investigations indicate that stored solutions of the compound, also known as HR, are stable when secluded from light and can be used as reagents. The distribution of HR between chloroform and aqueous solutions is shown to be dependent on the pH value. The reactions of HR with various metals are studied and the absorption spectra of the extracted compounds are taken. The composition of complexes made up of HR and various metals is determined. Transl. by R.B.

N70-42806# Brookhaven National Lab., Upton, N.Y.
MU TABLES FOR STEELS AS A FUNCTION OF TEMPERATURE
A. D. McInturff and J. Clauss 14 Apr. 1970 11 p
(BNL-14630) Avail: NTIS

Hysteresis curves were obtained for three types of steel at three different temperatures, 300, 77, and 4.2 K. These curves were then calibrated and measured, resulting in the mu tables presented. The apparatus consisted of two concentric rectangular pickup coils. The samples consisted of insulated laminations stacked on either side of the inner pickup coil (H) and enclosed by an outer coil. The output of these coils was integrated and displayed on an oscilloscope. The magnetizing force was supplied by a 13-in.-long copper solenoid in whose bore the pickup coils and samples were contained. It was found that the mu's at some given fields were temperature-dependent for the samples tested. Author (NSA)

N70-42834 Drexel Inst. of Tech., Philadelphia, Pa.
INHOMOGENEOUS CREEP PROPAGATION IN ANNEALED ALUMINUM
Leonard Morton Gold (Ph.D. Thesis) 1969 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-17910

The inhomogeneous behavior of creep in commercially pure (1100) aluminum is examined at the plateau regions of the stepped or staircase stress strain curve. The local response of a thin walled aluminum tube subjected to a combined tension and torsion stress condition is utilized in the description of the total deformation

of the ends of the specimen during the propagation of a slow creep wave. This wave nature of creep is used in conjunction with a viscoelastic creep model to determine the apparent stiffness and apparent viscosity of the material. A favorable correlation is obtained between the description of the total deformation and the observed behavior. Dissert. Abstr.

N70-42840# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURE AND PROPERTIES OF DIRECTIONALLY CRYSTALLIZED EUTECTICS
K. V. Gorev et al 5 Jun. 1970 9 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR: Ser. Fiz.-Tekhn. Navuk (Minsk), no. 1, 1969 p 104–106
(AD-710264; FTD-HT-23-296-70) Avail: NTIS CSCL 11/6

The article presents some results of studies of two eutectics which form thread-like structures (Al - NiAl sub 3 and Sb - MnSb) when directionally crystallized. TAB

N70-42909# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
STAINLESS STEEL CLADDING DEVELOPMENT Quarterly Progress Report, Period Ending 31 Mar. 1970
W. E. Ray Apr. 1970 31 p refs
(Contract AT(30-1)-4135)
(WARD-4135-9) Avail: NTIS

Microcharacterization and mechanical property testing, including biaxial tensile, biaxial stress rupture, and both uniaxial and biaxial creep were continued on WARD vacuum melted austenitic materials. Preliminary metallographic characterization of double vacuum melted Type 316 tubing, stainless steel fabricated by planetary swaging, has been completed for both 20 percent cold worked and solution annealed conditions. Comprehensive structure characterization of the planetary swaged materials, including transmission and scanning electron microscopy, electron and X-ray diffraction, and texture analysis by pole figures is almost completed. Post test stress rupture specimens have been classified according to rupture type and microstructural evaluation of selected specimens initiated. Biaxial stress rupture data scatter was evaluated, and a temperature correction procedure was proposed for the minor temperature variation (+ or – 15 F) inherent in the test. Author (NSA)

N70-42912# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
EFFECTS OF TEMPERATURE AND PRESSURE ON THE HYDRIDING OF Ti-5 Al-2.5 Sn (ELI)
R. L. Kesterson Jun. 1970 35 p refs
(WANL-TME-2702) Avail: NTIS

The effects of hydrogen pressures ranging from atmospheric to 600 psi and temperatures ranging from –25 to 400 F on the titanium-hydrogen reaction were studied. The Ti–5Al 2.5 Sn ELI (extra-low interstitial) alloy was found to react very rapidly with hydrogen at temperatures above 360 F if the surface was oxide free. The initial formation of surface hydrides occurred at temperatures which were inversely proportional to the pressure. As the pressure increased, hydriding occurred at lower temperatures. There was no significant effect of thin surface hydrides on the ambient tensile properties of this alloy. Ultra pure hydrogen and oxide-free surfaces were required to initiate hydriding. Author (NSA)

N70-42913# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
METHOD OF STRESS RELAXATION TESTING
C. A. Reeves, Jr. 24 Jun. 1970 28 p refs
(Contract W-7405-eng-26)
(Y-1726) Avail: NTIS

Two separate series of tests were performed to determine the stress relaxation properties of a uranium alloy (90 wt % U, 7-1/2 wt % Nb, 2-1/2 wt % Zr) at both room and elevated temperatures. Only the testing procedure and initial treatment of data are discussed. Author (NSA)

N70-42938# Brookhaven National Lab., Upton, N.Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOLUME 8, NO. 1 Bimonthly Technical Progress Review
Feb. 1970 40 p refs
(BNL-50236) Avail: NTIS

Information on research and development programs in the US in the area of high-temperature liquid metals is presented. Reviews are presented on fluid dynamics, heat transfer, materials development, instrumentation, component development, chemical aspects, and liquid metal purification. Author (NSA)

N70-42988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DISPERSION-STRENGTHENED ALLOYS FOR SPACE SHUTTLE HEAT SHIELDS
Neal T. Saunders *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 159–174 Supported in part by Defense Res. Board of Can. and Can. Com. Corp. (See N70-42976 24-30)
Avail: NTIS CSCL 11F

The technology development program is outlined for TD-NiCr sheet manufacturing and panel fabrication. Cold rolling and solid state welding are considered to offer promise, and high temperature ductility and oxidation resistance studies are described. A back-up alloy optimization and sheet manufacturing program is also reported. It is concluded that the dispersion strengthened alloy offers great potential for reentry heat shields in the temperature range of 1800 to 2000 F, and that the most crucial problem, oxidation resistance, will be more readily solved than the problems associated with other materials. N.E.N.

N70-42989*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REFRACTORY METAL HEAT SHIELD TECHNOLOGY FOR SPACE SHUTTLE
Bland A. Stein, Donald R. Rummler, and L. Robert Jackson *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 175–184 (See N70-42976 24-30)
Avail: NTIS CSCL 11F

In developing heat shields, the most important factor to be considered is reliability. The status of coated refractory metals for heat shields is reviewed. The important environmental factors which these shields must survive are listed. Specific heat shield configurations are reviewed and some of the configuration restraints which are important for coated refractory metals are discussed. A new heat shield configuration is proposed to satisfy these restraints. Finally, NASA contractual and in-house studies pertaining to coated refractory metal heat shield technology are listed. Author

N70-43014# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
AN INVESTIGATION OF THE SCATTER IN CONSTANT AMPLITUDE FATIGUE TEST RESULTS OF ALUMINIUM ALLOYS 2024 AND 7075
A. M. Stagg London Aeron. Res. Council 1970 114 p refs Supersedes RAE-TR-69075; ARC-31800
(ARC-CP-1093; RAE-TR-69075; ARC-31800) Copyright. Avail: NTIS; HMSO: £2 17s; BIS: $10.25

Previous investigations into the form of the distribution of constant amplitude fatigue test results are reviewed. The large amount of constant amplitude data for 2024 and 7075 materials

are analysed in terms of a log-normal distribution of life and it confirms that the scatter obtained in fatigue results increases with a decrease in the alternating stress amplitude. Scatter for the two materials are compared and the effects on the scatter of such parameters as notch acuity and mean stress are investigated. A simplified model of the fatigue mechanism indicates a possible correlation between the amount of scatter and the number of crack nuclei present in a specimen. Author (ESRO)

N70-43034# Institute for Physical Chemistry TNO, Utrecht (Netherlands).

THE THERMOCOUPLE Pt/CHROMIC OXIDE/Pt AND ITS USE IN DETERMINING MELTING CURVES AT HIGHER TEMPERATURES

Gerrit Hendrik Vonkeman (Ph.D. Thesis - Utrecht Univ.) Utrecht Univ. Apr. 1970 93 p refs Partly in DUTCH and partly in ENGLISH

Avail: NTIS

A special apparatus was constructed for measuring melting curves (temperature/heat content curves) at temperatures above 300 C. A Pt/Cr2O3/Pt thermocouple was proposed for the high temperature measurements and the electric properties of Cr2O3 are discussed. The calorimeter and the various measuring and regulating devices for automatic melting curve determination are described. In addition to several melting curves, accurate data on the thermoelectric power of the thermocouple in the range 300 to 1000 C are given. ESRO

N70-43082*# City Coll. Research Foundation, New York.

FUNDAMENTALS OF THE OXIDATION PROTECTION OF TANTALUM Final Report

M. Kolodney and R. A. Graff 1 Oct. 1970 164 p refs

(Grant NGR-33-013-017)

(NASA-CR-110894; CC-70-243-10) Avail: NTIS CSCL 11F

A fundamental study of the protection of tantalum by silicides has been performed. Thermodynamic properties of all tantalum silicides have been measured by an emf method using solid electrolytes. Considerable improvement over older data has been obtained. Measurements have also been made of the degradation of silicide coatings by diffusion of silicon into the tantalum substrate. These measurements permit estimates of time and temperature effects on lifetimes of coatings. Barriers to diffusion have been investigated, but no good ones found. Lastly, the oxidation process has been studied in terms of a silicide (TiSi-2) that forms a stable metal oxide. It has been shown that oxidation protection may be retained if the metal oxide can be embodied in the surface silica glass of the coating. Author

N70-43138# Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant.

EVALUATION OF SUBSTITUTIVE FILTER FRAMING MATERIALS IN CORROSIVE ENVIRONMENTS

C. C. Wright, F. N. Wiggins, and G. S. Petit 19 May 1970 20 p

(Contract W-7405-eng-26)

(K-TL-81) Avail: NTIS

Cadmium-plated steel has been used for many years as a framing material for filters because of its reasonable cost and resistance to typical atmospheres. The disposal of cadmium bearing solutions employed in plating, however, presents a health hazard. Since other steels have now become available at competitive prices, it was deemed desirable to evaluate them as possible substitutes for the cadmium-plated steel now in use. Muffler grade steel, chromized steel, zinc-coated steel and cadmium-plated steel were tested for corrosion-resistance in hydrochloric, nitric, and sulfuric acids, in acidic salt solution, and in moist, hot air. On the basis of the test results, muffler grade steel and chromized steel are considered adequate substitutes for the cadmium-plated steel presently used as a filter framing material. Muffler grade steel is preferable because it is not subject to edge attack as is the chromized steel. Author (NSA)

N70-43162 National Lending Library for Science and Technology, Boston Spa (England).

ON THE PROCESS OF SOLIDIFICATION DURING CONTINUOUS CASTING

D. Altenpohl, R.-C. Fornerod, and A. Steinegger 29 May 1970 21 p refs Transl. into ENGLISH from Z. Metall. (West Germany), v. 60, no. 7, Jul. 1969 p 576-583

(NLL-M-9158-(5828.4F)) Avail: Natl. Lending Library, Boston Spa Engl.: 2 NLL photocopy coupons

Selected examples are used to explain the relationship between solidification rate, solidification processes, and the structure of continuous castings. The examples include continuous casting of extrusion billets, rolling slabs, and strips of wrought aluminum materials. Author

N70-43167# Saarland Univ., Saarbrucken (West Germany). Inst. for Metal Physics and Metallurgy.

PLASTICITY AND ALLOY SOFTENING OF NEARLY INTERSTITIAL-FREE ALLOYS OF IRON WITH CHROMIUM, TUNGSTEN AND NICKEL Final Scientific Report, 1 Jan. 1967 - 31 Mar. 1969

W. Dickenscheid Wright-Patterson AFB, Ohio AFSC Jun. 1970 55 p refs

(Contract AF 61(052)-632)

(AD-709959; AFML-TR-70-148) Avail: NTIS CSCL 11/6

The influence of substituted Cr, W and Ni atoms on the plasticity of polycrystalline iron with very low interstitial content was investigated. Tensile properties of Fe-Cr and Fe-W alloys were determined between -100C and +400C. Both alloy series showed slight indications of alloy softening at about -40C. A series of experiments was performed in order to get additional information on the phenomenon of alloy softening in Fe-Ni alloys. Tensile properties, yield elongation, strain rate sensitivity, activation volumes, dislocation velocity exponents and the Hall-Petch parameter k were determined in the temperature range -196C to 400C. Dislocation structures were observed by transmission electronmicroscopy. At and above room temperature unalloyed iron displays glide not only on the closest packed planes but also on the less close packed ones. Glide on these less closely packed glide planes decreased at the lower temperatures although the number of glide planes on the main system did not increase. This behavior was not observed in the alloy containing Ni. Consequently the alloy softening resulted from an abnormal increase in the strength of unalloyed iron at the lower temperatures. Author (TAB)

N70-43179 National Lending Library for Science and Technology, Boston Spa (England).

THE EFFECT OF HIGH TEMPERATURE ANNEALING ON THE MICROSTRUCTURE OF AN AlZnMg 1 ALLOY AND ON THE SUSCEPTIBILITY TO LAYER AND STRESS CORROSION OF THE CORRESPONDING SHEET

G. Bassi et al 29 May 1970 13 p refs Transl. into ENGLISH from Z. Metallk. (West Ger.), v. 60, no. 3, Mar. 1969 p 179-184

(NLL-M-9157-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The changes in the microstructure of cast Al-Zn-Mg alloy caused by different annealing temperatures were studied using an electron microprobe and electron microscopy to determine stress and layer corrosion. Ingots, produced by the continuous casting process, together with a sheet were annealed for 24 hours at various temperatures, and then hot rolled to 7 mm thickness. The hot rolled plates were then age hardened for one month at room temperature. The results of the corrosion experiments are tabulated, and a discussion of the results is presented. It is concluded that layer corrosion is caused by seams of fine precipitates of an AlFeMn phase on the cell boundaries of the as-cast structure during heat treatment. In the interior of the cell, regions are formed which are sensitive to stress corrosion. F.O.S

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N70-41912 Missouri Univ., Rolla.
MASS AND HEAT TRANSFER THROUGH NONWETTABLE POROUS MEMBRANES
Chung-Liang Yeh (Ph.D. Thesis) 1969 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-19437

Evaporation of water through nonwettable porous membranes was studied under various pressures with various membrane thicknesses. The results of previous investigations at 1 atmosphere have been correlated into one equation for mass transfer resistance which has also been found to fit approximately new data obtained at 0.5, 2, and 3 atmospheres in this investigation. In the new data fluxes varied from 0.064 to 0.691 lb/sq ft hr. through glass fiber-Teflon membrane from 0.02 to 0.08 inch in thickness. Temperatures ranged from 80 to 260 F. A more theoretical equation was developed to explain variations from the equations based on 1 atmosphere data. This equation fits data under all pressures studied and is based on ordinary diffusion theory extended to include Knudsen diffusion effects, theoretical heat conduction through the membrane, and liquid film heat transfer coefficients. A relationship is also developed for mass transfer if concentration build-up is appreciable, and equations are given for the heat conducted through the membrane. Dissert. Abstr.

N70-41984*# Ohio State Univ. Research Foundation, Columbus.
PREPARATION OF PIGMENTS FOR SPACE-STABLE THERMAL CONTROL COATINGS, MAY 1969–JUNE 1970
W. B. Campbell, J. K. Cochran, A. Ezis, J. W. Hinton, and S. G. Nyches Jul. 1970 74 p refs
(Contract NAS8-21317)
(NASA-CR-102870) Avail: NTIS CSCL 11C

The identification and control of vapor phase reaction kinetics to produce pigments by homogeneous nucleating were achieved. Temperature capability of the vapor phase reaction system was extended beyond 1800 C. Vapor phase production of rutile and zinc orthotitinate pigments was investigated. Systematic variation of rutile particle size was accomplished and a constant volume growth rate was observed. Particle size distributions from electron microscopy were as narrow as any yet reported. Author

N70-42041# Bureau of Mines, Amarillo, Tex.
HELIUM: BIBLIOGRAPHY OF TECHNICAL AND SCIENTIFIC LITERATURE, 1963 (INCLUDING PAPERS ON ALPHA-PARTICLES)
Philip C. Tully, Billy Joe King, and Emily Dowdy 1970 869 p refs
(BM-IC-8467) Avail: SOD $7.00

This bibliography contains 3,062 different citations to technical and scientific literature about helium and alpha-particles abstracted by 13 abstract service publications during 1963. Multiple subject classification has increased the total number of entries to almost 5,000. Helium citations are listed by 23 major classifications. The number of subclassifications has been greatly increased to minimize the time required for literature search. The use of automatic data processing has been extended in compiling the bibliography. Author

N70-42080*# Whittaker Corp., San Diego, Calif. Research and Development Div.
THE DEVELOPMENT OF STRUCTURAL ADHESIVE SYSTEMS SUITABLE FOR USE WITH LIQUID OXYGEN (LOX) Summary Report, 20 Jun. 1969–19 Apr. 1970
Edward S. Harrison and Walter P. Fitzgerald, Jr. May 1970 46 p
(Contract NAS8-24389)
(NASA-CR-102850) Avail: NTIS CSCL 11G

Efforts are made to develop polymer systems demonstrating LOX compatibility and nonflammability in 100% oxygen environments. The polymer systems are to be used in adhesives, conformal coatings, and electronic embedment materials. Research has resulted in an approximately 60% increase in tensile shear strengths of all the allophanate cured polyurethane. Conformal coatings were successfully prepared and show great promise. Solvented spray coatings were similarly prepared in an initial feasibility study from fluorinated solvent and high quality nonflammable finishes were obtained. Newer curing schemes using cyanoguanidine, melamine and cyanuric trihydrazide have resulted in a significant improvement in moderately elevated temperature performance, with no sacrifice in the nonflammability characteristics. Author

N70-42093*# KMS Technology Center, Van Nuys, Calif.
OPACITY OF SILICON-HYDROGEN MIXTURES Final Report
Roger P. Main 22 May 1970 142 p refs
(Contract NAS3-13461)
(NASA-CR-72749) Avail: NTIS CSCL 11D

The equilibrium compositions, linear spectral absorption coefficients, and Planck and Rosseland mean absorption coefficients were computed for silicon-hydrogen mixtures with silicon/hydrogen mass ratios of 0., 0.005, 0.01, and 0.05, temperatures of 1600, 2200, 3000, 4000, 5000, 6500, 8000, and 10,000 K, and gas pressures of 100, 500 and 1000 atmospheres for the wave number range 7000–68,000 cm/1 (approximately). The possible presence of solid silicon was considered in the composition calculations, but not in the calculations of the optical constants. The major absorption was found to be due to molecular electronic transitions, photodetachment, photoionization, and neutral free-free processes, although each contributed strongly only for limited combinations of the temperatures, pressures, Si/H mass ratios, and spectral frequencies considered. The presence of condensed silicon in some of the mixtures is definitely indicated; this could have consequences for the optical constants of the mixtures and their utility as heat-absorbing media in proposed gaseous-core nuclear rocket propulsion systems. Author

N70-42099*# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
ELASTIC PROPERTIES OF THREE GRADES OF FINE GRAINED GRAPHITE AT 2000 C
M. O. Marlowe 25 Jun. 1970 31 p refs
(Contract NAS1-9852)
(NASA-CR-66933) Avail: NTIS CSCL 11B

The materials tested were ATJS, POCO 5Q, and POCO 9Q. The room temperature moduli were found to be directly proportional to the density of the specimens. However, each grade was characterized by a different density dependence and extrapolated moduli values at full density. The moduli of each grade increased with temperature, the initial rate of increase increasing in the order POCO 5Q, POCO 9Q, and ATJS. The moduli reached maximum values in the temperature ranges 1250 to 1550 C for the POCO 5Q, and 1700 to 1750 C for the POCO 9Q but no maxima were achieved below 2000 C for the ATJS. A hysteresis of up to 500 C was observed in the moduli on cooling. There was considerable spread in the temperature dependence of the elasticity of the samples from a given graphite grade. Author

N70-42115*# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF THE KINETICS OF CRYSTALLIZATION OF SEVERAL HIGH TEMPERATURE GLASS SYSTEMS Quarterly Status Report, 1 May–31 Jun. 1970

James F. Bacon 1 Sep. 1970 23 p ref
(Contract NASw-2013)
(NASA-CR-114227; QSR-3; Rept-J910939-3) Avail: NTIS CSCL 11C

Research designed to measure the possible usefulness of the UARL 344 glass composition indicates that fibers can be readily and continuously drawn from this composition through a multihole (six hole) platinum-rhodium bushing at high rates of speed. The process operating variables can also be adjusted so that the glass fibers can be started through the use of simple mechanical devices without any help from the operator. Composites made with UARL 344 glass fiber and epoxy show full-size notched Charpy impact test values of 30 foot pounds or about three times the value of comparable tests on boron fiber-epoxy composites and more than seven times as high as obtained with graphite fiber-epoxy resin composites tested similarly. Twenty new nontoxic (beryllia-free) glass compositions were prepared and about half were examined in bulk form. Preliminary studies of the mode of fracture of the new UARL glass compositions are discussed and electron micrographs are included to illustrate the contrast between the fracture surfaces for a material such as Corning Glass Works 9608 Pyroceram and UARL 344 glass. Comparative studies of several UARL glasses and a borosilicate sight glass carried out on half-size notched Charpy impact specimens are also included. Author

N70-42121# National Bureau of Standards, Washington, D.C. Office of Standard Reference Materials.
CATALOG OF STANDARD REFERENCE MATERIALS
Jul. 1970 83 p Supersedes NBS-Spec-Publ-260, 1969; See N69-40930
(NBS-Spec-Publ-260) Avail: SOD $0.75

A descriptive listing of the various standard reference materials distributed by the National Bureau of Standards is given. These materials are used to calibrate measurement systems and to provide a central basis for uniformity and accuracy of measurement. The unit and quantity, the type, and the certified characterization are listed for each material, as well as directions for ordering. Author

N70-42127# Michigan State Univ., East Lansing. Dept. of Chemistry.
PREPARATION AND VAPORIZATION THERMODYNAMICS OF EUROPIUM OXIDE BROMIDES
John M. Haschke and Harry A. Eick [1970] 18 p refs Supported in part by NSF
(Contract AT(11-1)-716)
(COO-716-56) Avail: NTIS

Orthorhombic trieuropium tetraoxide monobromide, Eu_3O_4Br, ($a = 11.98 \pm 0.03$, $b = 10.36 \pm 0.02$, $c = 5.92 \pm 0.01$ A); tetragonal europium monoxide monobromide, EuOBr, ($a = 3.926 \pm 0.003$, $c = 8.019 \pm 0.008$ A) and hexagonal trieuropium monoxide tetrabromide, Eu_3OBr_4 ($a = 9.825 \pm 0.004$, $c = 7.510 \pm 0.003$ A) were prepared and their vaporization reactions investigated. Single crystal X-ray diffraction data for Eu_3O_4Br are consistent with space group Pmnm or Pmn2. Values of delta H deg sub 1399 and delta S deg sub 1399 were obtained from target collection Knudsen effusion measurements of the equilibrium dibromide pressure according to the reaction $3\ Eu_3O_4Br(s)$ yields $4\ Eu_2O_3$ (s, monoclinic) + $EuBr_2$ (g) + Br (g). Estimated thermodynamic data are presented for EuOBr. Author

N70-42135 National Lending Library for Science and Technology, Boston Spa (England).
ORIENTATION DRAWING OF POLYESTER FIBRES
S. S. Aleksandrinskii et al 29 May 1970 7 p refs Transl. into ENGLISH from Khim. Volok. (USSR), no. 6, 1969 p 13-15
(NLL-M-9166-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The orientation drawing of polyethylene terephthalate (PET) fibers was studied in machines with a heated top disc and a flat heater between the drawing dics. The process of polyester orientation in machines of this type shows that the drawing occurs at the zone of discharge from the heated disc. X-ray analysis indicates that crystallization of the fibers occurs following high stress and orientation. The optimum temperature for drawing is shown to be 80 C. Above 100 C PET crystallizes rapidly which reduces the possibility of orientation. The effects of drawing temperature variations on the following properties are discussed: density, birefringence, shrinkage, tenacity, and extension at break. F.O.S.

N70-42183*# Lockheed-Georgia Co., Marietta.
AN APPLICATIONS STUDY OF ADVANCED COMPOSITE MATERIALS TO THE C-130 CENTER WING BOX
P. H. Petit [1970] 160 p refs
(Contract NAS1-9540)
(NASA-CR-66979) Avail: NTIS CSCL 11D

An application study of advanced filamentary composite materials to the C-130 center wing box was performed. The study included three design approaches: (1) composite reinforcement of the existing box while installed on the aircraft, (2) composite reinforcement during fabrication in accordance with a new design, and (3) an all composite design. Consideration of cost, manufacturing feasibility and reliability led to the choice of approach (2). This particular approach enabled a 13 percent weight savings with boron/epoxy reinforcement of aluminum as compared to the current aluminum design. Cost of the composite material largely determined the increased cost over that of the current aluminum design. Preliminary fatigue analysis indicated the life of the composite reinforced box equal to or greater than that of the current aluminum box. A demonstration program designed to provide flight experience for two C-130 aircraft equipped with composite reinforced center wing structure is outlined. Author

N70-42189*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
INVESTIGATION OF ZERO GRAVITY EFFECTS ON MATERIAL PROPERTIES Final Report, 6 Aug. 1969 - 6 Mar. 1970
Thaddeus J. Fabiniak Apr. 1970 61 p refs
(Contract NAS8-24952; Pros. Zero-G)
(NASA-CR-102874; CAL-KC-2862-P-1) Avail: NTIS CSCL 11G

Various combinations of metal (Al, Ag, Zn and Sn) and carbon or boron-carbide powders were compacted by powder metallurgical methods and subjected to liquid-phase sintering in a vacuum environment. The material combinations were chosen so that the major effect of dissimilar phase densities (g-responsive) and varying liquid-phase surface tensions on the final phase distribution could be determined. The feasibility of designing and implementing experiments to study the effects of space environment on the behavior of near-surface defects in metals was also investigated. It was concluded that absorption of atomic oxygen, present in the space environment, might occur during liquid-phase sintering experiments. Also discussed is the general wetting problem and its relation to the strong interdependence of diffusion mechanisms and related defect migration (active in the various sintering stages) and absorption. Author

N70-42190*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
PROVISIONAL THERMODYNAMIC FUNCTIONS FOR HELIUM 4 FOR TEMPERATURES FROM 2 TO 1500 K WITH PRESSURES TO 100 MN/m (1000 ATMOSPHERES)
R. D. McCarty 1 Aug. 1970 202 p refs
(NASA Order R-06-006-046; NASA Order W-12745)
(NASA-CR-114212; NBS-9782) Avail: NTIS CSCL 11D

The thermodynamic properties for helium 4 from 2 to 1500 K with pressures to 100 MN/sq m (1000 atmospheres) are

presented. Entropy, enthalpy, internal energy, specific heat, speed of sound, density and temperature are tabulated for selected isobars. For convenience, these data are given in both pressure units of MN/sq m and atmospheres. An equation of state covering the entire range of pressure and temperature is presented. Equations for the density of the saturated liquid and vapor are included as well as an equation which represents the 1958 helium vapor pressure temperature scale. Author

N70-42229*# Pittsburgh Univ., Pa. Space Research Coordination Center.
THE ROOM TEMPERATURE DEFORMATION AND FRACTURE OF SEVERAL POLYCRYSTALLINE GRAPHITES
Clarence A. Andersson (Ph.D. Thesis) 19 Aug. 1970 240 p refs
(Grant NGL-39-011-002)
(NASA-CR-114253; SRCC-138) Avail: NTIS CSCL 11G

The tensile deformation and fracture were correlated to the particle sizes, the particle preferred orientations, the bulk densities, and the stress axis directions. The total strain at a given stress was found to consist of three components: (1) a linear elastic strain, (2) an elastically constrained nonlinear plastic strain, and (3) a residual strain arising from the relief of internal stresses by crack formation. The dependence of the elastic strain on the preferred orientation, the stress axis direction, the fraction porosity, and the extent of deformation were determined. A fracture criterion was derived from quantitative analysis of the effects of particle sizes, pore fractions, degrees of preferred orientation, and the stress axis directions on each of the parameters of the equation for the brittle fracture of a body containing large cracks. By considering transverse strain interactions between neighboring crystallites as well as longitudinal interactions, a method was developed to calculate the elastic moduli of polycrystalline materials from both the single crystal elastic constants and the X-ray diffraction preferred orientation. Author

N70-42264# Picatinny Arsenal, Dover, N.J.
PREDICTION OF FAILURE TIME FOR SOME ADHESIVE BONDED JOINTS
Elise McAbee, William C. Tanner, and David W. Levi Jul. 1970 24 p refs
(AD-709585; PA-TR-4006) Avail: NTIS CSCL 13/5

Data are given for shear and tensile testing of adhesive bonds under a constant rate of loading. A rate equation is then used to predict useful life from the mechanical data. The correlations are in general quite satisfactory, providing that the failure is cohesive within the adhesive. Author (TAB)

N70-42273*# Scientific Translation Service, Santa Barbara, Calif.
SILASTENE COATING FOR POLLUTION REDUCTION IN A HOT-SHOT WIND TUNNEL. INSPECTION BY SPECTROSCOPY [REVETEMENT DE SILASTENE POUR LA REDUCTION DES POLLUTIONS DAS UNE SOUFFLERIE A ARC. CONTROLE PAR SPECTROSCOPIE]
F. Carrega et al Washington NASA Oct. 1970 7 p refs Transl. into ENGLISH from Rech. Aerosp. (Paris), no. 1, 1970 p 51-53
(Contract NASw-2035)
(NASA-TT-F-13258) Avail: NTIS CSCL 11C

A silastene coating applied to the walls of the Arc 2 wind tunnel is described. It increases the lift time of the wind tunnel by five times. Author

N70-42282# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
MILLIMETER AND SUBMILLIMETER WAVE DIELECTRIC MEASUREMENTS WITH AN INTERFERENCE SPECTROMETER Final Report, 15 Apr. 1966 - 14 Apr. 1970
Albert McSweeney and Albert P. Sheppard 14 Apr. 1970 64 p refs
(Contract Nonr-991(13))
(AD-709983) Avail: NTIS CSCL 11/7

Dielectric constants, loss tangents, and transmission coefficients for a large number of materials were measured in the millimeter and submillimeter wave part of the electromagnetic spectrum. Instrumentation and measurement techniques for obtaining these data are described in detail. These include interference spectroscopy using a black body source with appropriately designed filters, and coherent techniques using a Fabry-Perot interferometer or a short-circuited waveguide filled with powdered samples. The measurements show that many materials commonly employed in the microwave spectrum tend to be very lossy as a function of increasing frequencies toward 2000 GHz (67/cm). Some materials, such as Teflon, polyethylene, Rexolite, and slip-cast fused silica, were observed to have relatively low dissipation factors so as to represent excellent candidates for component and electromagnetic window applications throughout the millimeter and submillimeter wave part of the spectrum. Author (TAB)

N70-42293*# Cincinnati Univ., Ohio.
THERMODYNAMIC PROPERTIES OF TERNARY REFRACTORY CARBIDES. PART 4: RELATIONS BETWEEN THERMODYNAMIC PROPERTIES, BONDING, AND COMPRESSIBILITY Technical Report, 1 Jul. 1967 - 30 Jun. 1969
M. Hoch and S. Yamauchi Dec. 1969 23 p refs
(Contract NGR-36-004-014; F33615-67-C-1565)
(NASA-CR-114267; AD-700766; AFML-TR-69-209-Pt-4) Avail: NTIS CSCL 11B

The high temperature thermodynamic data obtained on ternary carbides having the sodium-chloride type structure have been correlated with the bonding and mechanical properties of these carbides. The metal-metal bonding on the metal sublattice in the carbide is the same as in the binary body-centered cubic metals. The variation of the carbon-carbon interaction energy and the metal-carbon interaction energy indicates that the metal-carbon bonds are localized bonds. From the variation of the difference in metal-carbon interaction energy with composition the compressibility of the carbides at elevated temperature can be calculated. The values are in excellent agreement with values derived from room temperature mechanical properties measurements. Author (TAB)

N70-42306*# Avco Corp., Lowell, Mass. Systems Div.
PREPARATION AND STUDY OF SYNTHETIC PROTEIN-LIKE MATERIALS FOR HIGH PERFORMANCE ADHESIVE SYSTEMS Final Report
W. S. Port and B. W. Burrell 1 Jun. 1970 44 p refs *Its* Ser. A
(Contract NAS8-24074)
(NASA-CR-102846; AVSD-0288-70-RR) Avail: NTIS CSCL 11A

The program comprised the following: (1) treatment and characterization of the surface of aluminum alloy 2014-T6, (2) evaluation of two methods for depositing the polymers on the substrate surfaces: deposition from solution and in situ polymerization, (3) production of primer coatings by respective depositions from aqueous solution of poly-L-Serine and from dimethylformamide solution of poly-L-Tyrosine, and (4) lap shear testing of primed coupons bonded with an amine cured epoxy resin (Epon 828), and an anhydride cured epoxy resin (Epoxylite 5403). Three different primer thicknesses were evaluated by lap shear test for each polyamino acid with each epoxy adhesive. In Epoxylite 5403 bonded systems, both primers decreased the lap shear strength by about 1000 psi. In the Epon 828 systems, poly-L-Serine brought about little or no improvement, but poly-L-Tyrosine (in thickness up to about one mil) increased the lap shear strength. Author

N70-42311# Bell and Howell Research Center, Pasadena, Calif. Electronic Materials Div.
DEVELOPMENT OF GaAs INFRARED WINDOW MATERIAL Semiannual Report, 1 Dec. 1969 – 31 May 1970
Alan G. Thompson Jun. 1970 31 p refs
(Contract N00014-70-C-0132; ARPA Order 306)
(AD-709576) Avail: NTIS CSCL 11/2

The choice of window material for the 10.6 micron region and high power carbon dioxide lasers is discussed, and reasons for choosing GaAs given. The theory of semi-insulating GaAs is summarized. The growth, electrical properties and optical properties of chromium-doped GaAs are described with particular reference to the 10.6 micron region. The use of other materials such as GaSb, the refinement of te high-resistivity GaAs and the development of large-diameter boules are considered. Author (TAB)

N70-42343*# Los Alamos Scientific Lab., N.Mex.
CMF RESEARCH ON CARBON AND GRAPHITE Summary Progress Report, 1 May – 31 Jul. 1970
Morton C. Smith Oct. 1970 27 p ref Sponsored in part by NASA
(Contract W-7405-eng-36)
(NASA-CR-114210; LA-4526-MS; Rept. 14) Avail: NTIS CSCL 11B

Progress in research on carbon and graphite is reported, including determination of calcining temperatures, effects of calcining temperature on properties, hot-molded graphites made from LV coke, extruded Santa Maria graphites, particle packing, binder chemistry, graphite-carbide composites, effects of porosity on graphite properties, skin effects in graphite, and graphitization. R.B.

N70-42413# Norwegian Inst. of Tech., Trondheim. Inst. for Theoretical Electro-Technics.
EXPERIMENTS WITH ELASTIC SURFACE WAVES IN PIEZOELECTRIC CERAMICS
H. Engan Jul. 1969 41 p refs
(ELAB-TE-128) Avail: NTIS

Several experiments with elastic surface waves in PZT-4 and PZT-8 materials, including measurements of phase velocities, interdigital transducer impedances and surface wave attenuation are described. Some beam-forming methods, a method for visualization of the surface waves and the observation of a new type of surface wave, which is strongly dependent on the electrical boundary conditions, are also described. Author (ESRO)

N70-42542# Royal Aircraft Establishment, Farnborough (England).
SOME (FLUOROALKYL) AROMATIC SURFACTANT MATERIALS
J. Thrower and M. A. H. Hewins Apr. 1970 32 p refs
(RAE-TR-70056) Copyright. Avail: NTIS

A general method for the synthesis of fluoro alkyl-substituted aromatic compounds is described. Using this patented method, good synthetical routes were established to polystyrenes containing long-chain fluoro alkyl groups. Syntheses for (perfluoro heptyl)-benzoic and -benzene sulfonic acids were also devised. The potential of these materials as surfactants is discussed: the fluoro alkyl-substituted polystyrenes did not show sufficiently low critical surface tensions to be of interest as surfactants for fabrics, while the benzoic and benzene sulfonic acids proved unpromising as surfactants for electroplating baths. Author (ESRO)

N70-42585# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
MECHANICAL PROPERTIES OF URANIUM AND PLUTONIUM BASED CERAMICS [PROPRIETES MECANIQUES DES CERAMIQUES A BASE D'URANIUM ET DE PLUTONIUM]
Andre Padel Jun. 1970 83 p refs In FRENCH; ENGLISH summary
(CEA-R-3953) Avail: NTIS

The sound velocities and elastic constants of UC, UN, UO2 and (UC, UN) were measured as functions of porosity at ambient temperature. The influence of the oxygen content on the Young's modulus of (U, Pu)O sub (2 + or – x) was also determined. The elastic constants and internal friction (at the fundamental longitudinal resonant frequency) of UC, UN, UO2, (U sub 0.82, P sub 0.18)N, and (U sub 0.80, P sub 0.20)O sub (2 + or – x) were also measured between 25 and 1,300 C. Author (ESRO)

N70-42610 National Lending Library for Science and Technology, Boston Spa (England).
ABRASIVE COMPOUNDS FOR BARREL FINISHING [BARERU SHIAGEYO KEMMAZAI]
W. Funabashi Jul. 1970 11 p refs Transl. into ENGLISH from Nagoya Kogyo Gijutsu Shikensho Hokoku (Nagoya), v. 11, no. 2, 1962 p 76–81
(NLL-RTS-5863) Avail: Natl. Lending Library, Boston Spa, Engl.: 20s; 3 NLL photocopy coupons

Measurements of polishing amounts and surface roughness after polishing were made and are reported for several abrasives. The barrel was a porcelain cylinder lined inside with rubber. The abrasives were barrel polishing media powders; media powders obtained from a perforated submerged barrel, Shinooka silica sand, aluminum oxide, and a mixture containing primarily aluminum oxide, with silicon dioxide, titanium oxide, and traces of other oxides. N.E.N.

N70-42822# Oak Ridge National Lab., Tenn.
THE DEVELOPMENT OF RADIATION-RESISTANT INSULATORS Progress Report, 1 Jul. 1967 – 1 Jul. 1969
M. J. Kelly and W. W. Parkinson Aug. 1970 60 p refs
(AD-710263; ORNL-TM-2966) Avail: NTIS CSCL 18/8

The apparent electrical conductivity of high-resistance plastics was examined from the standpoint of dielectric relaxation processes as well as steady-state conductivity. The observed, time-dependent conductivity of high-purity polystyrenes, commercial plastics of lower purity and of the copolymer in use for dosimeters can be accounted for on the basis of dielectric charging and low values of conductivity, both varying with the polar nature of the base polymer and the impurities. During irradiation the conductivity increases greatly depending on the dose rate and decays after irradiation with a time dependence related to the composition of the specimen. The currently used material, a copolymer of styrene and alpha-methyl styrene (Corex 2508), was found to have unusually rapid decay of conductivity following irradiation. By polymer fractionation and by varying the synthesis ingredients, the chemical species active in reducing conductivity was identified as sulfate chain ends arising from persulfate initiator in the polymerization recipe. Styrene homopolymers have been synthesized with sulfate end groups and shown to have as low conductivity as the copolymer. Polymers with sulfate end groups and (NH4) cation have shown low but erratic conductivity and polystyrenes having end groups of moderate polarity have lower dielectric charging prior to irradiation and some reduction in postirradiation conductivity. Methods are proposed for development work to exploit these possibilities for improving plastic insulators. Author (TAB)

N70-42636# Iowa State Univ. of Science and Technology, Ames Lab.
ELECTROLYTIC BEHAVIOR OF YTTRIA AND YTTRIA STABILIZED HAFNIA
Jon David Schieltz (Ph.D. Thesis) May 1970 162 p refs
(Contract W-7405-eng-82)
(IS-T-361) Avail: NTIS

The electric conductivity of undoped yttria was measured over an oxygen partial pressure range of 1 to 10 to the minus 16th

power atm and a temperature range of 700 to 1,000 C. Open circuit emfs were measured over the same temperature interval and oxygen partial pressures of 10 to the minus 6th power to 10 to the minus 50th power atm. Electric conductivity measurements on yttria–hafnia compositions between 6 and 20 mole percent yttria were performed between 800 and 1,000 C and oxygen partial pressures of 1 to 10 to the minus 12th power atm to determine the optimum composition for further investigations as a possible electrolyte. Open circuit emf measurements, coulometric titration experiments, and polarization studies were performed to determine the electrolytic behavior of the chosen composition. Results of the investigation are presented in tabular form. NSA

N70-42654# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
THERMOGRAVIMETRY OF PHENOL-FORMALDEHYDE POLYCONDENSATES. PART 3: CARBON/GRAPHITE CLOTH REINFORCED COMPOSITES TO 1400 C Technical Report, Mar. 1968–Oct. 1969
R. W. Farmer May 1970 84 p refs
(AD-709884; AFML-TR-65-246-Pt-3) Avail: NTIS CSCL 11/4

Carbon and graphite cloth reinforced phenolic composites find ablative thermal protection uses as nose tips, heat shields, and rocket nozzle elements. Weight kinetics are used in predicting the performance of these and related materials. The most general source of the necessary kinetic parameters is thermogravimetry. Kinetic parameters n, A, and E were empirically calculated for the pyrolysis of phenolic molding, phenolic/carbon cloth, and phenolic/graphite cloth materials. The empirical kinetic parameters predicted thermograms within 2% residual weight of the parent one. Of three typical bands of disagreement, the largest usually occurred within the third band near 800C. A two-step phenolic/carbon cloth thermogram was in part due to cloth pyrolysis with probable synergistic resin interaction. The graphite cloth was relatively inactive for the phenolic/graphite cloth composite. Author (TAB)

N70-42693# Battelle Inst., Frankfurt am Main (West Germany).
[HEAT-RESISTANT PLASTICS] Industrial Colloquium
Bruno Vollmert (Tech. Univ. Karlsruhe), Friedrich Grundschober, Walter Gruensteidl (N.V. Philips, Eindhoven), and Manfred Sander *In its* Battelle Inform. No. 2 Sep. 1968 p 37–42 Colloq. held in Frankfurt, 2 Feb. 1968 (See N70-42691 24-34)
Avail: NTIS

The high-temperature characteristics of heat-resistant organic polymers and the properties of polyimide moulding resins are described. Practical applications of polyimides and future developments of thermostable plastics are discussed. ESRO

N70-42714# Brown Univ., Providence, R.I. Engineering Materials Research Lab.
ELEVATED TEMPERATURE CREEP OF POLYURETHANE UNDER NONLINEAR TORSIONAL STRESS WITH STEP CHANGES IN TORQUE
J. S. Y. Lai and W. N. Findley Jun. 1970 33 p refs
(Contract ARPA SD-86)
(AD-710409; EMRL-43; ARPA-E74) Avail: NTIS CSCL 11/9

Constant stress experiments, recovery and multi-step creep tests in torsion in the nonlinear range were performed at different temperatures up to 160F. It was found that the results could be described by a power function of time whose exponent was independent of stress and temperature. Most of the temperature effect and most of the nonlinearity were found in the coefficient of the time-dependent term. The nonlinearity was described by the multiple integral representation, and the changes in stress were adequately predicted by the modified superposition method, except at the highest temperatures. Author (TAB)

N70-42787# Utrecht State Univ. (Netherlands). Organic Chemistry Lab.
INTERACTIONS IN ACETYLENES: AN NMR APPROACH
Douwe Rosenberg (Ph.D. Thesis) Jul. 1970 103 p refs Partly in DUTCH and partly in ENGLISH
Avail: NTIS

The charge distribution in the ground state of heterosubstituted acetylenic compounds was investigated by means of nuclear magnetic resonance spectroscopy. The proton magnetic resonances H-C-C-P and H-C-C-P(O) and the C-13 and P-31 resonances were measured. The factors influencing the chemical shifts and the spin-spin coupling constants in acetylenes are critically reviewed. Quantum chemical calculations on acetylenes are surveyed and mass spectrometry, nuclear quadrupole resonance, and electric dipole data on the same class of compounds are discussed. ESRO

N70-42789# Sandia Corp., Albuquerque, N.Mex. Composite Materials Development Div.
FILAMENT-REINFORCED CERAMICS: FABRICATION AND TESTING
W. L. Cyrus, M. Moss, and D. M. Schuster Jun. 1970 18 p refs Sponsored in part by AEC
(SC-DR-70-365) Avail: NTIS

The feasibility of preparing metal filament-reinforced ceramics by plasma spraying has been demonstrated. Approximately 13 volume percent of either 0.005-inch-diameter tungsten or molybdenum wire was incorporated into an aluminum oxide matrix by a process of alternate filament winding and spraying. Filament degradation, which results from fiber-matrix interaction in such processes as hot pressing, was not observed, and strength of the filaments was retained in the composite. A significant change in the mode of failure of the brittle ceramic was observed. Although a network of cracks appeared at the failure strain of unreinforced alumina, catastrophic crack propagation was suppressed in the reinforced ceramic. The load-carrying capability of the filaments was solely responsible for the observed increases in tensile strength of the composite, but such increases were evident at strains greatly exceeding the ultimate strain of the ceramic, i.e., after cracking of the matrix. Author (NSA)

N70-42898# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
DETERMINATION OF FREE SURFACE ENERGY OF FILAMENTS Technical Report, Nov. 1966–Aug. 1969
Pierce M. Williamson Jun. 1970 45 p
(AD-710207; AFML-TR-70-107) Avail: NTIS CSCL 11/5

Two new, but similar, methods are demonstrated for determining the free surface energy and the surface tension of polymeric filaments. These two surface characteristics are obtained from chart-recorded force-elongation curves. Under-curve-energy values and microcreep elongations are processed for the determination of free surface energy, while on-curve-force values and microstrain elongations are processed for the determination of surface tension. The polymer used is polystyrene of 45,000 molecular weight. Filaments formed by melt extrusion without drawing or thermal decomposition range in diameter from 0.01270 cm to 0.0528 cm. Rates of filament elongation: 0.00001 cm/min, .0001 cm/min, and 0.0508 cm/min. 9The actual values obtained for the numerically identical characteristics are: 308 ergs/sq cm for free surface energy and 313 dynes/cm for surface tension. Author (TAB)

N70-42929# General Dynamics/Fort Worth, Tex.
FILAMENTARY COMPOSITE LAMINATES SUBJECTED TO BIAXIAL STRESS FIELDS Quarterly Progress Report, 1 Mar.–30 May 1970
20 Jun. 1970 85 p refs Prepared for IIT Res. Inst., Chicago, Ill.

(Contract F33615-70-C-1298)
(AD-708499; QPR-1) Avail: NTIS CSCL 11/4

The behavior of materials subjected to biaxial stress fields has always been a critical factor in the design of high efficiency structures; this basic statement holds true for all materials both homogeneous and anisotropic. However, experience, empiricisms, and analysis, combined with careful experimentation, have reduced the problem for homogeneous metals to advanced engineering. A program was therefore initiated to: Define the problem areas and develop basic understanding of behavior and peculiarities of composite materials under biaxial loading; generate reliable mechanical property data on lamina and on multidirectional laminates subjected to biaxial stress fields; investigate analytical expressions which attempt to describe the test results; develop useful design curves and tables and write a chapter to be included in the Structural Design Guide for Advanced Composites Applications to provide ability to predict reliable material strength properties for a designer. TAB

N70-42956# Radio Corp. of America, Harrison, N.J. Electronic Components.
SILICON GERMANIUM THERMOELECTRIC MATERIALS AND MODULE DEVELOPMENT PROGRAM Quarterly Report, 1 Oct. – 31 Dec. 1969
31 Dec. 1969 66 p refs
(Contract AT(29-2)-2510)
(ALO-(2510)-8; QR-8) Avail: NTIS

Activities in the program are organized in subprograms for development of SiGe thermoelectric materials, Air-Vac module development, and cascaded converter development. During the report period the emittance of N and P SiMo samples subjected to a range of operating and processing conditions was determined. It was determined by means of a series of compatibility tests that platinum foils reacted with the silicon, phosphorus, and germanium components of SiGe, and thus were not suitable for use in a SiGe converter without further development effort. The fabrication of the C-4 converter was completed on schedule and performance testing initiated. The MinK (C-2) and the foil (C-3) insulated 5-watt converters were operated in nitrogen to simulate the performance in air to give a measure of the capability of converters with each insulation performing in launch pad environments. A zirconia base fibrous insulation was tested to determine its high temperature performance characteristics in both vacuum and nitrogen. NSA

N70-42969# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF OXYGEN COMPOUNDS IN LUBRICATING OIL ON INITIAL RUNNING-IN PROCESSES OF FRICTION COUPLES IN INTERNAL COMBUSTION ENGINES
S. V. Ventsel et al 5 Jun. 1970 14 p refs Transl. into ENGLISH from the publ. 'Voprosy Treniya i Problemy Smazki' Moscow, Nauka, 1968 p 201–206
(AD-710260; FTD-HT-23-277-70) Avail: NTIS CSCL 11/8

The effect of the oxygen compounds formed in used oils on wear and on engine performance resulting from the running-in process was studied. Cylinders and piston rings of the diesel engine D-16 were tested in the laboratory of a tractor factory. Wear, microhardness, and microroughness of friction surfaces were determined as indicators of the running-in process. This process was accelerated with the used oil as compared with the fresh oil or with special lubricant VTU. The used oil produced the best friction surface for loads occurring under field conditions. Author (TAB)

N70-42990*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
NONMETALLIC REUSABLE THERMAL PROTECTION SYSTEMS
D. H. Greenshields *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 185–193 (See N70-42976 24-30)
Avail: NTIS CSCL 11D

The most highly developed and most thoroughly investigated reusable thermal protection materials for use on the shuttle are metals which have been alloyed and specially treated to exhibit oxidation resistance and high strength at elevated temperatures. However, there exist nonmetallic materials which exhibit inherent chemical stability and/or high strength properties under entry conditions, and thus are potentially better choices for reusable heat shield application. The development of two such materials, refractory oxide and carbon composites, are being pursued to assure that the potential advantages of these materials are adequately investigated. Author

N70-43000*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CRYOGENIC INSULATION
James E. Curry *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 297–308 (See N70-42976 24-30)
Avail: NTIS CSCL 13D

External and internal insulations for the booster and orbiter are described. The deficiencies are identified, and the current materials are evaluated. N.E.N.

N70-43001*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ENVIRONMENTAL EFFECTS ON SPACE SHUTTLE MATERIALS
C. E. Cataldo *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 309–318 (See N70-42976 24-30)
Avail: NTIS CSCL 11D

The effects on materials of temperatures from −423 to +3000 F and of atmospheres from high humidity ground exposure to space vacuum are considered. Emphasis is given to propellant compatibility with tankage alloys, high pressure gaseous hydrogen effects on metals, life support and environmental control systems, and high temperature effects on materials. N.E.N.

N70-43002*# Ministry of Technology, London (England).
CARBON FIBRE COMPOSITES FOR REUSABLE SPACE SHUTTLE STRUCTURES
W. G. Molyneux *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 319–331 (See N70-42976 24-30)
Avail: NTIS CSCL 11D

The program and work in progress on the evaluation of properties of composites and the design, fabrication, and testing of structural components are described. The material for most purposes are preferred in the form of a pre-impregnated tape with a resin formulation, with fiber type and surface condition to suit the particular application. N.E.N.

N70-43003*# Maschinenfabrik Augsburg-Nurnberg A. G., Munich (West Germany).
FIBER REINFORCED COMPOSITES FOR SPACE SYSTEMS
F. Laussermair, W. S. Lassmann, H. Kreft, and M. Simon *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 332–356 refs (See N70-42976 24-30)
Avail: NTIS CSCL 11D

The experimental and qualification program to develop fiber reinforced cryogenic pressure vessels is described, with special emphasis on fiber reinforced materials. A weight comparison shows that the structural weight for future space systems can be considerably reduced if the usual metal fuel and pressure tanks are replaced by fiber tanks. Author

N70-43053# Naval Research Lab., Washington, D.C. Organic Chemistry Branch.
ADHESIVE BOND FAILURES IN AIRCRAFT HONEYCOMB SANDWICH COMPOSITES Interim Report
T. R. Walton and J. E. Cowling 15 Jun. 1970 29 p refs
(AD-710352; NRL-7077) Avail: NTIS CSCL 1/3

A number of approaches were initiated to improve bond strength and durability of honeycomb core-sandwich structures, some of which are described in the report. The overall objective was to determine why and how these composites fail and then determine what can be done to eliminate or reduce these failures. Failure, in part, appears to be caused by an undercutting type of corrosion which destroys the bond. The adhesives themselves appear also to be partially to blame. Although their initial strength is probably sufficient, their durability to environmental conditions is poor. The deficiencies in the adhesive are inadequate moisture resistance, high void content, and brittleness. To correct these problems, corrosion-inhibitive primers and treatments are being studied, new water-resistant resins are being synthesized, and bonding procedures are being studied. Author (TAB)

N70-43090# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
VIBROSCOPIC DENIER DETERMINATION FOR HIGH MODULUS FIBERS Technical Report, Mar. – Apr. 1970
Walter H. Gloor Jun. 1970 13 p
(AD-710592; AFML-TR-70-151) Avail: NTIS CSCL 11/5

Determination of fiber linear density by vibroscopic (vibrating string) techniques requires a correction for specimen stiffness when applied to fine diameter, high modulus fibers. The magnitude of this correction is discussed, together with the factors from which it arises and methods of calculation. (Author) TAB

N70-43112 National Lending Library for Science and Technology, Boston Spa (England).
RECENT DEVELOPMENTS IN THE EPOXY FIELD
K. J. Jellinek 1970 32 p refs Transl. into ENGLISH from Kunstoffe (West Germany), v. 55, no. 2, 1965 p 74–84 Presented at Technol. of Exposy Resins Symp., Esslingen, 21 – 25 Sep. 1964
(NLL-EE-Trans-1282-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

The state of development of special types of epoxy resins with properties which are better than the standard resins is reported. The special resins are those having a lower viscosity without loss in strength of the cured moldings, resins having improved heat distortion and long term heat resistance, better resistance to tracking and arcing, greater flexibility, and inflammability. Author

N70-43193# National Aeronautical Establishment, Ottawa (Ontario).
A Cr-Ti-Si DIFFUSION COATING FOR THE NIOBIUM ALLOY B66: AN INVESTIGATION OF SOME COATING PARAMETERS
J. M. Trenouth and M. S. Grzedzielski Dec. 1969 42 p refs /*ts* Mech. Eng. Rept. MS-126
(NRC-11309) Avail: NTIS

Chromium-titanium and chromium-titanium-silicon diffusion coatings were formed on specimens of the niobium alloy B66 by vacuum pack cementation. Some of the coating parameters for formation of the chromium-titanium diffusion coating were investigated with respect to the amount and structure of the coating formed. The amount of diffusion alloying of silicon with previously formed chromium-titanium coatings was independent of the chromium-titanium coating conditions and thickness. As a result of this constant silicide layer thickness on different thicknesses of the chromium-titanium coating, varying structures of the final chromium-titanium-silicon coating were obtained. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N70-41865 New Mexico State Univ., University Park.
MAXIMUM RESPONSE PREDICTIONS OF A NONLINEAR MULTI-DEGREE OF FREEDOM SYSTEM
Bobby Joe Donham (Ph.D. Thesis) 1969 184 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-19117

Equations for predicting the maximum response of a multi-degree of freedom, nonlinear, close coupled, undamped system subjected to velocity pulse loading are presented to enable a rapid estimate of response without the aid of large electronic computers. The equations are based upon the energy conservation principle, and assumes assume the stored elastic energy content at the first incidence of yielding to remain a constant value. Dissipated energy is taken from computer solutions of given systems and empirical equations are used to represent the variation of dissipated energy with the structure variables. Application of this method is restricted to a class of structures which have from two to eight equal masses, each subjected to the same initial velocity. Elastic spring stiffnesses between masses may vary linearly from KR at the base, to R at the free end, where K may assume values from one to two. Dissert. Abstr.

N70-41882# National Aeronautical Lab., Bangalore (India).
SPLINE APPROXIMATION AS APPLIED TO AERONAUTICAL PROBLEMS
P. Ramamoorthy and C. L. Narayana Nov. 1969 22 p refs
(NAL-TN-20) Avail: NTIS

A method based on spline approximation is presented for problems of interpolation in aeronautics. This method is programmed for the NAL Sirus computer, and is very reliable compared with existing methods. Analysis of pressure data obtained from wind tunnel testing on wing models or determination of the boundary layer characteristics from a known pressure distribution on an aerofoil are among the problems to which this method is applied. Author

N70-41928*# Bell Aerospace Co., Buffalo, N.Y. Research Dept.
ADAPTIVE COMPUTING TECHNIQUES
Erich Schmitt 10 Apr. 1970 58 p refs
(Contract NAS8-21417)
(NASA-CR-102845; Rept-9500-920179) Avail: NTIS CSCL 12A

Optimizing an unknown multimodal multidimensional function, with only the ability to evaluate the function at chosen points is presented. The speed of convergence of the well-known simple global random search technique is shown to be very low, making this technique inappropriate for a small number of dimensions. An adaptive local algorithm using adaptive step size is extended to a global algorithm. The rate of convergence depends strongly on the speed of convergence of the local algorithm. The local part of the algorithm is improved by the additional adaptation of direction information gained during each function evaluation. The global adaptive search method is shown to solve a trial problem of high degree of difficulty with respect to the closeness of the optima. Author

N70-41939# California Univ., Los Angeles. Western Management Science Inst.
GENERALIZED BENDERS DECOMPOSITION
Arthur M. Geoffrion Apr. 1970 39 p refs Presented at the Nonlinear Programming Symp., Madison, Wis., 4-6 May 1970 /*ts* WMSI Working Paper 159
(Grant NSF GP-8740)
(AD-708878) Avail: NTIS CSCL 12/2

J. F. Benders devised an approach for exploiting the structure of mathematical programming problems with complicating variables. Such problems have the property that temporarily fixing the values of certain variables renders the remaining optimization problem considerably more tractable--perhaps breaking apart into a number of independent smaller problems, or being solvable by a highly efficient known algorithm, or reducing to a convex program in continuous variables whereas the original problem is partly nonconvex or discrete. In this paper, Benders approach is generalized to a broader class of programs in which the parameterized subproblem need no longer be a linear program. Nonlinear convex duality theory is employed to derive the natural families of cuts corresponding to those in Benders case. The conditions under which such a generalization is possible are examined in detail from both the theoretical and computational viewpoints. An illustrative specialization is made to the variable factor programming problem introduced by R. Wilson, where it appears to offer an especially attractive approach. Author (TAB)

N70-41952*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
RECURSIVE STATE ESTIMATION FOR A SET-MEMBERSHIP DESCRIPTION OF UNCERTAINTY Interim Report
Dimitri P. Bertsekas and Ian B. Rhodes May 1970 36 p refs
(Grants NGL-22-009-124; AF-AFOSR-1724-69)
(NASA-CR-114119; AD-706114; AFOSR-70-1245TR) Avail: NTIS CSCL 12A

The paper is concerned with the problem of estimating the state of a linear dynamic system using noise-corrupted observations, when input disturbances and observation errors are unknown except for the fact that they belong to given bounded sets. The cases of both energy constraints and individual instantaneous constraints for the uncertain quantities are considered. In the former case, the set of possible system states compatible with the observations received is shown to be an ellipsoid, and equations for its center and weighting matrix are given, while in the latter case, equations describing a bounding ellipsoid to the set of possible states are derived. All three problems of filtering, prediction, and smoothing are examined by relating them to standard tracking problems of optimal control theory. The resulting estimators are similar in structure and comparable in simplicity to the corresponding stochastic linear minimum variance estimators, and it is shown that they provide distinct advantages over existing schemes. Author (TAB)

N70-41968*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ON THE MINIMAX REACHABILITY OF TARGET SETS AND TARGET TUBES
Dimitri P. Bertsekas and Ian B. Rhodes May 1970 43 p refs
(Grants NGL-22-009-124; AF-AFOSR-1724-69)
(NASA-CR-114118; AD-706079; AFOSR-70-1246TR) Avail: NTIS CSCL 12A

The paper is concerned with the closed-loop control of discrete-time systems in the presence of uncertainty. The uncertainty may arise as disturbances in the system dynamics, disturbances corrupting the output measurements or incomplete knowledge of the initial state of the system. In all cases, the uncertain quantities are assumed unknown except that they lie in given sets. Attention is first given to the problem of driving the system state at the final time into a prescribed target set under the worst possible combination of disturbances. This is then extended to the problem of keeping the entire state trajectory in a given target tube. Necessary and sufficient conditions for reachability of a target set and a target tube are given in the case where the system state can be measured exactly, while sufficient conditions for reachability are given for the case when only disturbance-corrupted output measurements are available. An algorithm is given for the efficient construction of ellipsoidal approximations to the sets involved, and it is shown that this algorithm leads to linear control laws. The application of the results in this paper to pursuit-evasion games is also discussed. Author (TAB)

N70-42065# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
SOLUTION OF A NONLINEAR PROBLEM OF GAMMA SPECTROSCOPY BY NEWTON METHOD USING SMOOTHING OF LINEAR STEPS
V. Gadzhokov, L. Aleksandrov, and Ch. Stoyanov 1970 10 p refs In RUSSIAN
(JINR-P10-5043) Avail: AEC Depository Libraries

Solution of a nonlinear physical problem by the Newton method using smoothing of linear steps is presented. An illustrating example is given with the initial data, and the solution obtained by the method suggested is included. Author (NSA)

N70-42084# Stanford Univ., Calif. Dept. of Computer Science.
NUMERICAL TECHNIQUES IN MATHEMATICAL PROGRAMMING
R. H. Bartels, G. H. Golub, and M. A. Saunders May 1970 67 p refs
(Contracts N00014-67-A-0112-0029; AT(04-3)-326; Grant NSF GJ-408)
(AD-709584; STAN-CS-70-162) Avail: NTIS CSCL 12/2

The application of numerically stable matrix decompositions to minimization problems involving linear constraints is discussed and shown to be feasible without undue loss of efficiency. Part A describes computation and updating of the product-form of the LU decomposition of a matrix and shows it can be applied to solving linear systems at least as efficiently as standard techniques using the product-form of the inverse. Part B discusses orthogonalization via Householder transformations, with applications to least squares and quadratic programming algorithms based on the principal pivoting method of Cottle and Dantzig. Part C applies the singular value decomposition to the nonlinear least squares problem and discusses related eigenvalue problems. Author (TAB)

N70-42105# Illinois Univ., Urbana. Dept. of Computer Science.
HIGH ORDER STIFFLY STABLE METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS
M. K. Jain and V. K. Srivastava Apr. 1970 47 p refs
(Contract AT(11-1)-1469; Grant NSF GJ-217)
(COO-1469-162; Rept-394) Avail: NTIS

Ordinary differential equations with greatly different time constants arise in a wide variety of important physical problems. The predictor-corrector method of solution is examined. The existence of stiffly stable methods of order as high as eight has been known for some time. A class of methods for finding methods of order greater than eight is examined. Author

N70-42110# Illinois Univ., Urbana. Dept. of Computer Science.
OPTIMAL STIFFLY STABLE METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS
M. K. Jain and V. K. Srivastava Jun. 1970 17 p refs
(Contract AT(11-1)-1469)
(COO-1469-164) Avail: NTIS

One parameter method for the numerical integration of stiff differential equations, i.e., systems with widely separated time constants are discussed. The methods which are optimal, in terms of least amount of solution history data to be saved at each step of the corrector iteration, are known for order as high as six. In one parameter methods the stability and accuracy are controlled by the same variable gamma. Suitable values of gamma lead to methods which have either optimal accuracy or optimal stability. The methods of order six are presented. Author

N70-42116*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
ON A THEOREM OF K T CHEN
Martin Braun [1970] 14 p refs
(Grants NGL-40-002-015; AF-AFOSR-693-67B; NSF GP-15132)
(NASA-CR-14226) Avail: NTIS CSCL 12A

Mappings M of the real line into itself of the form M: x sub 1 = x + hx to the nu power + f(x) are considered. It was recently proved by the Schauder fixed point theorem that M possessed the normal form x sub 1 = x + hx to the nu power + cx to the (2 nu − 1) power. The contracting mapping principle is used to prove that M has the normal form x sub 1 = x + hx to the nu power, thus eliminating the extraneous term cx to the (2 nu − 1) power. Sharp estimates are derived on how fast the iterates of a point enter or leave the origin. It is noted that the developed methods can be generalized to prove the existence of invariant manifolds for differential equations whose linear part has one eigenvalue zero.
Author

N70-42126# Illinois Univ., Urbana. Dept. of Computer Science.
A STUDY OF METHODS FOR SELECTION OF QUOTIENT DIGITS DURING DIGITAL DIVISION
Daniel E. Atkins (Ph.D. Thesis) Jun. 1970 120 p refs
(Contract AT(11-1)-1018; Grants NSF GJ-812; NSF GJ-813)
(COO-1018-1204; Rept-397) Avail: NTIS

A class of non-restoring division schemes are considered in which redundancy is introduced into the representation of the quotient thereby permitting quotient digits to be selected from highly truncated versions of the divisor and partial remainders. The mechanism for selection of quotient digits is a limited precision model of the full precision division which it controls by the generation of simple microprogram instructions. A cost versus performance analysis for a large class of quotient selection mechanisms (model divisions) is developed. The class is defined in terms of a block diagram and a set of ten design parameters. By varying the structure of the sub-blocks and the values of the parameters, the model division scheme ranges from that of forming quotient digits by multiplying the divident by the inverse of the divisor, to that of a direct table look-up of the quotient digit. Algorithms are described which synthesize near minimal cost realizations of the most complicated sub-blocks: a combinatorial logic network to produce appropriate estimates of the reciprocal of the divisor, and a combinatorial logic network to generate a quotient digit directly as a function of the bits in estimate of the divisor and partial remainder.
Author

N70-42132# Illinois Univ., Urbana. Dept. of Computer Science.
MULTIPLE PRECISION COMPUTATION OF LEGENDRE FUNCTIONS
Ruth Ann Potts Fleck (M.S. Thesis) Jun. 1970 157 p refs
(Contract AT(11-1)-1469)
(COO-1469-167; Rept-404) Avail: NTIS

A group of FORTRAN programs are presented which calculate various associated Legendre functions for arguments greater than 1. These programs are machine independent in the sense that FORTRAN is a language available on most computers and the modifications necessary to run on a different computer are relatively simple. The program can be considered as the first step toward a tabulation on tape since it would only be necessary to make the decisions as to values of the argument and format of the tape and then obtain the function values from the programs described.
Author

N70-42138*# Clemson Univ., S.C. Dept. of Mathematics.
APPLICATION OF GENERALIZED EXPONENTIAL SMOOTHING AND MATRIX PSEUDOINVERSES TO ESTIMATION IN DYNAMIC SYSTEMS Final Report
W. B. Owen and B. J. Prochaska Mar. 1969 42 p refs
(Contract NAS8-11259)
(NASA-CR-102849) Avail: NTIS CSCL 12A

A review of the filtering problem and the Kalman solution are presented. To obtain a new Kalman-type filter generalized exponential smoothing is presented and the relevant results of pseudoinverses of matrices are reviewed. The new filtering equations are introduced and briefly studied with respect to unbiasness.
Author

N70-42146# RAND Corp., Santa Monica, Calif.
OPTIMAL INCENTIVE CONTRACTING: A CONSTRAINED GAME THEORY MODEL
Joseph L. Midler Jun. 1970 19 p refs
(AD-709535; P-4404) Avail: NTIS CSCL 12/2

Several versions of the negotiation of the parameters of incentive contracts between a government and private contractors are formulated as game theoretical models. This framework permits one focus upon a number of aspects that have previously been overlooked such as the interaction of the participants, the lack of domination by one side or the other, constraints upon the players strategies, and the possible joint interests of the one party in the other players outcome. Computational methods of solution are suggested.
Author (TAB)

N70-42149# Illinois Univ., Urbana. Coordinated Science Lab.
ON DECODING EUCLIDEAN GEOMETRY CODES
C. L. Chen Jul. 1970 19 p refs
(Contracts DAAB07-67-C-0199; F30602-70-C-0014)
(AD-709342; R-479; UILU-ENG-70-224) Avail: NTIS CSCL 9/4

An improved decoding algorithm for Euclidean Geometry codes is presented. It is shown that this class of codes can be orthogonalized in less than or equal to 3 steps. That is, it requires no more than 3 steps of majority logic in decoding these codes. This results greatly reduces the decoding complexity without reducing the error-correcting capabilities of the codes. The proposed decoding algorithm is a general one. In fact, it is applicable for all codes that are constructed from finite geometries. The application to Projective Geometry codes will be presented in a separate report.
Author (TAB)

N70-42155*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
GREEN'S FUNCTIONS FOR STURM-LIOUVILLE PROBLEMS
Jack Simons 17 Aug. 1970 20 p refs
(Grant NGL-50-002-001)
(NASA-CR-114246; WIS-TCI-400) Avail: NTIS CSCL 12A

It is shown how Green's function for any inhomogeneous Sturm-Liouville (S-L) problem can be constructed once two independent solutions of the homogeneous problem are known. The general technique is illustrated by considering two specific S-L problems. When the parameter appearing in the S-L equation is equal to an eigenvalue of the homogeneous S-L problem an added difficulty arises. The method of constructing a generalized Green's function which deals with this difficult case is also treated by example.
Author

N70-42179*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ON BEHAVIOR STRATEGY SOLUTIONS IN FINITE EXTENDED DECISION PROCESSES
V. A. Utgoff and R. L. Kashyap Jun. 1970 189 p refs
(Grants NGR-15-005-021; NSF GK-1970; AF-AFOSR-1776-69)
(NASA-CR-114238; TR-EE-70-24) Avail: NTIS CSCL 12A

Techniques are developed for finding best behavior strategies on arbitrary information collection schemes. These techniques make it possible to search in any given game for strategies which are minimally complex but acceptably effective. Best strategies are defined as those strategies which maximize a player's expected return against all possible strategies that can be employed by the

other player, and the decision process is thus considered as a two-person, zero-sum, finite extended game. A pursuit and evasion game is also studied and best behavior strategies are determined for the pursuer and the evader when both players gather and retain all the information defined to be available to each of them. Author

N70-42240# RAND Corp., Santa Monica, Calif.
QUEUEING THEORETIC ANALYSIS OF CONTRACTORS' SEQUENTIAL BIDDING PROBLEMS, 2
Leonard H. Zacks Jul. 1970 27 p refs
(AD-709539; P-4412-2) Avail: NTIS CSCL 12/2

The document discusses the queueing theoretic analysis of contractors sequential bidding problems. TAB

N70-42244*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
APPRAISAL OF AN ITERATIVE METHOD FOR BOUND STATES
Peter D. Robinson, Tony T. Warnock, and Norman Anderson 18 Dec. 1969 20 p refs
(Grants NGL-50-002-001; NSF GP-12832)
(NASA-CR-114188; WIS-TCI-375) Avail: NTIS CSCL 12A

An iterative method for determining bound-state eigenvalues and properties of the radial Schroedinger equation is appraised. The method stems from iterating an integral equation. The basic theory is briefly reviewed, and calculations are performed for the Coulomb and screened Coulomb potentials. Convergence is rapid for eigenvalues but slow for expected values. There is some sensitivity to the choice of numerical integration formula. Regarded as a numerical method, this approach may be most competitive for the determination of zero-energy potential-strength eigenvalues. Its disadvantages are listed. Analytical improvements to eigenfunctions can be easier to obtain by iteration than by perturbation, and some success has been achieved. A simple example suggests that the rate of convergence of an iterated eigenfunction sequence is less than that of a related perturbation sequence unless the choice of starting function is bad. Author

N70-42258*# Brown Univ., Providence, R.I. Div. of Applied Mathematics.
REGULARIZATION OF VECTOR FIELDS BY SURGERY
Robert Easton May 1970 16 p refs
(Contracts NGL-40-002-015; AF-AFOSR-693-67B)
(NASA-CR-114268; AD-706899; AFOSR-70-1484-TR) Avail: NTIS CSCL 12A

Regularization is a common procedure in the study of differential equations. The usual method is to multiply the vector field by a suitably chosen positive scalar function which vanishes on the set of singularities of the vector field. The new vector field or differential equation thus obtained may have no singularities and thus may be easier to study. The qualitative behavior of solutions off the set of singularities is the same for both vector fields. Another method of regularization involves surgery and roughly, the idea is to excise a neighborhood of the singularity from the manifold on which the vector field is defined and then to identify appropriate points on the boundary of the region. The regularization of the planar 2-body problem on surfaces of constant negative energy was first discussed by Levi-Civita. The 2-body problem is regularized using surgery. This method gives a new way of looking at the classical result and makes apparent the geometrical reasons for its success. It is possible to regularize the three body problem on surfaces of nonzero angular momentum using the present methods. This result will be treated in a subsequent paper. Author (TAB)

N70-42286*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
THE SYNTHESIS OF OPTIMAL CONTROLS FOR LINEAR PROBLEMS WITH RETARDED CONTROLS
H. T. Banks, Marc Q. Jacobs, and M. R. Latina Jul. 1970 97 p refs
(Grants NFL-40-002-015; AF-AFOSR-693-67B; NSF GP-15132)
(NASA-CR-114256; CDS-TR-70-4) Avail: NTIS CSCL 12A

Optimization problems involving linear systems with retardations in the controls are studied in a systematic way. Some physical motivation for the problems is discussed. The topics covered are: controllability, existence and uniqueness of the optimal control, sufficient conditions, techniques of synthesis, dynamic programming. A number of solved examples are presented. Author

N70-42301# California Univ., Los Angeles. School of Engineering and Applied Science.
QUADRATIC OPTIMAL CONTROL OF DISTRIBUTED PARAMETER SYSTEMS WITH STOCHASTIC INPUTS
Merriman Staton Sholar May 1970 96 p refs
(Grant AF-AFOSR-1547-68)
(AD-709710; UCLA-ENG-7046; AFOSR-70-2038TR) Avail: NTIS CSCL 12/1

The report concerns the design of a quadratic optimal regulator for systems described by time-invariant linear partial differential equations with Gaussian white noise disturbance of the state and measurement. Point control at the boundary or interior points is treated as a special case of distributed control. Such a system is shown to separate into independent design of the best feedback controller and state estimator. Sufficient conditions are established in terms of solutions to a Hamilton-Jacobi equation which is solved by eigenfunction expansion of Hamilton-Jacobi canonical systems associated with controller and estimator Ricatti equations. A finite series representation of the state and co-state in terms of the low frequency eigenfunctions of the canonical systems is shown to provide an approximation to the optimal regulator. Examples are presented for controlling scalar diffusion processes in cases of distributed and point control and observation. Author (TAB)

N70-42319 Stevens Inst. of Tech., Hoboken, N.J.
ON THE DESIGN AND ANALYSIS OF DISCRETE-TIME SATURATING STOCHASTIC CONTROL SYSTEM BY THE USE OF STATISTICAL LINEARIZATION
Richard Peter Marzec (Ph.D. Thesis) 1969 406 p
Avail: Univ. Microfilms: HC $18.45/Microfilm $5.20 Order No. 21297

The stationary, infinite time stochastic regulator problem with bounded control is considered. The dynamic programming equation for this problem is solved in an approximate manner, resulting in a set of design equations for an approximate, linearized solution. This linearized solution is related to the nonlinear system which it approximates. It is shown that under certain conditions a solution to the nonlinear system exists near the approximate, linearized solution. Finite and infinite time systems having bounded control laws which are arbitrarily specified are considered. It is shown how statistical linearization can be applied in order to obtain linearized approximations to the given nonlinear systems. Error bounds are obtained for the infinite time systems and for certain classes of finite time systems. In addition to the time-domain analysis, a method is presented for the analysis of discrete time, stationary nonlinear stochastic systems by means of frequency domain techniques. Dissert. Abstr.

N70-42333 Northwestern Univ., Evanston, Ill.
OPTIMAL CONTROL OF SYSTEMS WITH TIME DELAY
Gene Arthur Lawrence (Ph.D. Thesis) 1969 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 70-103

The complete description of systems with time delay requires state variables defined in a function space rather than in a finite vector space; the control of such systems is not as thoroughly documented as the simpler systems with no delay. Necessary and

sufficient conditions an optimal solution satisfies have been proved elsewhere for broad classes of problems. This paper extends somewhat suffcient conditions for optimality of linear systems with quadratic performance index and infinite terminal time. Then a solution is given for two classes of problems: (1) a plant with delay between two linear subsystems; and (2) a performance index resulting in minimum control energy. The optimal control is expressed as a functional of the plant state function. Dissert. Abstr.

N70-42353*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
METHODS FOR THE DIRECT CALCULATION OF REDUCED DENSITY MATRICES
John Peter Simons (Ph.D. Thesis) 19 Jun. 1970 160 p refs
(Grant NGL-50-002-001)
(NASA-CR-114247; WIS-TCI-390) Avail: NTIS CSCL 12A

The mathematical difficulties involved in formulating atomic and molecular quantum mechanics in terms of reduced density matrices are considered. Constructing approximately N-representable density matrices which can be used in variational calculations is studied in detail and their effects on calculated properties are also analyzed. Use is made of field theoretical Green's functions to directly determine the second-order density matrix of an N-fermion system which is applied to the ground state of the helium atom as a test case. A technique for calculating, in a self-consistent fashion, the first- and second-order density matrices of atoms and molecules is presented. This scheme makes use of a generalized random-phase approximation to obtain equations for various spin components of the density matrices. The results of applying this method to helium, lithium, and beryllium are presented. Finally, the first- and second-order density matrices of symmetry-projected single determinants are derived and analyzed. Author

N70-42354# Texas A&M Univ., College Station. Inst. of Statistics.
PARAMETRIC PROGRAMMING
R. R. Hocking and R. L. Shepard Aug. 1970 30 p refs
(Contract N00014-68-A-0140; Proj. Themis)
(AD-710009; THEMIS-TR-24) Avail: NTIS CSCL 12/2

The report consists of two papers on parametric programming. The first considers solution of certain nonconvex programs and the second characterizes the parametric response function. Author (TAB)

N70-42374 Iowa Univ., Iowa City.
TOPOLOGICAL ANALYSIS OF DEPENDENT SOURCE NETWORKS
Leonard Farber (Ph.D. Thesis) 1969 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-21690

Topological formulas are obtained for the open-circuit impedance and short-circuit admittance functions of a general linear two-port network. The network contains an arbitrary number of each of the following types of elements: voltage-dependent current sources, current-dependent voltage sources, voltage-dependent voltage sources, current-dependent current sources and passive elements. Each controlling variable is assumed to be either an open-circuit voltage or a short-circuit current. A suitable representation is also given for a controlling variable associated with a finite nonzero admittance. The source and load ports of the network are first terminated with appropriate independent sources, and a connected, directed, labeled and weighted linear graph is associated with the terminated network. Dissert. Abstr.

N70-42442 Georgia Inst. of Tech., Atlanta.
THE DYNAMIC CHARACTERISTICS OF A NONLINEARLY DAMPED SYSTEM
Robert M. Laurenson (Ph.D. Thesis) 1969 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-22598

An investigation of the dynamic response of a nonlinear system was conducted. The particular case of a system, whose nonlinear terms appear in its dissipation function, was considered. The nonlinear damping function was represented as a general polynomial in the system's velocity. Therefore, the dissipation function consisted of the combination of a Coulomb friction term, a linear, velocity proportional term, and nonlinear terms proportional to higher powers of the velocity. The research dealt with the specific case of a single degree of freedom system and consisted of two areas of investigation. Two forms for the approximate representation of the solution of the system's equation of motion were formulated. The first of these was an extension of the classic Kryloff-Bogoliuboff approximation technique. The second was a further application of a perturbation series approximation. Dissert. Abstr.

N70-42470 California Univ., Berkeley.
EXCITATION IN RANDOM GRAPHS
Parviz Jabedar-Maralani (Ph.D. Thesis) 1969 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-18937

The problem of excitation spread in infinite and finite random graphs is investigated. Associated with each branch of the graph is a probability of existence. This probability is a strictly decreasing function of the Euclidian length of that branch. This leads to the concept of distance biased random graphs. For those values of p which are greater than some critical probability p sub c the system reaches a nonzero steady state. P sub c depends on the threshold theta of each vertex and this dependence is investigated. The total number of steady states and their stabilities are discussed. A general method of evaluating the critical probability p sub c for an arbitrary infinite regular random graph is given. In the case of finite random graphs, the expected number of excited vertices at a specific time is obtained and algorithms are given for evaluating the probability of excitation of an arbitrary vertex. Dissert. Abstr.

N70-42481 Illinois Univ., Urbana.
OPTIMAL CONTROL OF LINEAR DIFFERENTIAL AND DIFFERENCE GAMES
Patrick David Shea (Ph.D. Thesis) 1969 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-976

Difference games in which one player has incomplete noisy measurements as well as difference and differential games in which the controls are constrained are considered. The cost functions used are quadratic in the states and controls. Dynamic programming is used in the difference games to find the optimal strategies in feedback form. The recursive relations are derived for finding these linear feedback controllers. In the case of games with incomplete information, the estimation equations are also developed. The saddle point principle is used to calculate the optimal strategies for the differential game with constrained control. A technique is developed for finding the regions of state space in which the control is saturated, unsaturated, or undefined. Dissert. Abstr.

N70-42484 Utah Univ., Salt Lake City.
ON DISCONTINUOUS KALMAN FILTERING
Kurtlee James Karlinsey, Jr. (Ph.D. Thesis) 1969 235 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 69-19655

This thesis is a rigorous proof that Kalman continuous time filtering equations provide the linear least squares estimate of the solution of a linear stochastic differential equation observed through additive nonstationary white noise. This thesis not only gives a rigorous proof for this result but also extends the result so that various functions involved need not be continuous but need only satisfy certain Lebesgue integrability requirements. Then the Kalman filtering equations are somewhat changed in form, becoming more general. In particular, the Kalman variance equation is no longer

a matrix Riccati ordinary differential equation but a generalization of the idea of an ordinary differential equation, namely an ordinary differential equation whose forcing function is a generalized function, or distribution (in this case a matrix of generalized functions). Dissert. Abstr.

N70-42514# Naval Weapons Lab., Dahlgren, Va.
RESOLUTION IN FIRST ORDER THEORIES
Hartmut G. M. Huber and Alfred H. Morris, Jr. Jul. 1970 59 p refs
(AD-710209; NWL-TR-2405) Avail: NTIS CSCL 12/1

The basic principles that are involved in resolution theory for first order theories are examined. Resolution theory is developed from an axiomatic point of view, which provides a general foundation for specific proof finding strategies in first order theories. Most of the specific strategies that have been formulated for the predicate calculus are presented as natural applications of this theory. Author (TAB)

N70-42523# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
A PERTURBATION THEORY IN TERMS OF REDUCED MATRICES
John E. Harriman 24 Jul. 1970 27 p refs
(Grants NGL-50-002-001; NSF GP-7409)
(NASA-CR-114251; WIS-TCI-391) Avail: NTIS CSCL 12A

A simple perturbation theory has been developed for reduced density matrices which are known to be N-representable as functions of some set of independent parameters. Formulas are presented for single and double perturbations through second order. Extension to higher order would be possible, but involved. The results do not depend explicitly on the order of the density matrix, and when the N-particle density matrix is used, the formulas can be reduced to those of conventional Rayleigh– Schrodinger theory. Details are given for the special cases of spin-unrestricted or extended SCF density matrices and CI or optimized multiconfiguration density matrices which are known to be N-representable. Author

N70-42530 IIT Research Inst., Chicago, Ill.
ON THE RESPONSE OF NONLINEARITIES TO MULTIPLE COSINE WAVE IMPUTS
Ronald Gunnar Sea (Ph.D. Thesis) 1969 249 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.25 Order No. 69-19086

General formulas are found which facilitate the digital computation of frequency components in the output of an arbitrary nonlinearity. Several mathematical representations of an arbitrary nonlinearity- Fourier series, integral transform, and power series, are considered. It is shown that if a nonlinearity is represented by a Fourier series, its response to a multiple cosine wave input may be evaluated very rapidly on the computer. A formula is derived for the output terms which expresses the multiple cosine wave response in terms of its spectral response to a single cosine wave. This approach is generalized to include the case where Gaussian noise is present in the input. A series formula for the amplitude of any output term is derived. The results include several formulas and algorithms. Examples are given and digital computer programs for one of the methods are listed. Also included are appendices and tables which facilitate the application of the methods to nonlinearities that are piecewise linear. Dissert. Abstr.

N70-42536# Ohio State Univ. Research Foundation, Columbus.
ON SOME FUNCTIONS RELATED TO THE EXPONENTIAL INTEGRALS Final Scientific Report
Carl Kaplan Wright-Patterson AFB, Ohio ARL Jun. 1970 24 p refs
(Contract F33615-67-C-1758)
(AD-710217; ARL-70-0097) Avail: NTIS CSCL 12/1

The generalized exponential integrals ((E sub n) sup m)(x) are represented in matrix form where (m) denotes the rows and n the columns. Thus, ((E sub n) sup1)(x) comprises the family of the well-known exponential integrals (E sub n)(x). Subsequent rows comprise the families of generalized exponential integrals. Associated with each row of functions are the recursion formula and derivative. When these two relations are looked upon as functional equations, they yield for each row of exponential integrals related functions much in the manner of the relationship of, say, the Legendre polynomials and Legendre functions of the second kind. This paper shows in detail the derivation of the related sets of functions and in addition the derivation of the series expressions for the first three families of exponential integrals. The purpose of these series expressions is to suggest a particular form for the related functions. Author (TAB)

N70-42547 Princeton Univ., N.J.
ON SIMPLE DISJUNCTIVE DECOMPOSITION OF SWITCHING FUNCTIONS
Vincent Yun-Shen Shen (Ph.D. Thesis) 1969 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-18186

Two techniques for obtaining all simple disjunctive decompositions of a switching function are described. The first proceeds by testing for all decompositions with a bound set of size two. Under given conditions the test for a pair of variables shows that some larger bound sets, containing the two variables for which the test was conducted, can not yield a decomposition. It is shown that the algorithm is better than the decomposition chart method as it is usually used but that the running time still increases as an exponential function of the number of variables involved. The second method operates on a function given as an expression using the operations AND, EXCLUSIVE OR, and complementation. An algorithm which is very effective for non-decomposable functions is also discussed. Dissert. Abstr.

N70-42563# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ON SINGULAR ARCS AND SURFACES IN A CLASS OF QUADRATIC MINIMIZATION PROBLEMS
D. H. Jacobson Aug. 1970 27 p refs
(Contract N00014-67-A-0298-0006)
(AD-710013; TR-613) Avail: NTIS CSCL 12/1

A class of quadratic minimization problems is studied whose optimal control functions are partially singular. An explicit expression is obtained for the (n - 1) dimensional singular surface and it is shown that the optimal value function is twice continuously differentiable across this surface; this allows the piecing together of known sufficiency conditions for totally singular and totally bang-bang arcs to obtain sufficient conditions for optimality for this class of partially singular problems. A neighboring optimal feedback control law is suggested by these results. The closing sections of the paper are concerned with sufficient conditions for nonexistence of optimal singular controls in quadratic minimization problems. Author (TAB)

N70-42567# RAND Corp., Santa Monica, Calif.
NOTES ON COMBINATORIAL MATHEMATICS: A DERIVATION OF A MEASURE OF RELATIVE BALANCE FOR SIGNED DIGRAPHS AND A CHARACTERIZATION OF EXTENSIVE RATIO SYSTEMS
Robert Z. Norman and Fred S. Roberts Jun. 1970 66 p refs
(Contract F44620-67-C-0045)
(AD-709874; RM-6201/2-PR) Avail: NTIS CSCL 5/11

In order to extend the Heider and Cartwright-Carary theory of balance in social structures (signed digraphs), a measure of relative balance is needed which is derived from some plausible axioms and which reflects the balance ordering, i.e., the relation that one social structure is more balanced than another. This study approaches the problem indirectly by first axiomatizing a measure

of distance and then relating balance to distance. It is shown that the axioms determine the balance ordering uniquely, subject to the specification of a certain parameter. This parameter is interpreted and some brief remarks are given on how it can be chosen. The measure of balance is then applied to a particular sociological situation. The problem of axiomatizing the balance ordering more directly is approached by formulating a second axiomatization that results in the same representation theorem and also solves the problem of axiomatizing extensive ratio systems. Author (TAB)

N70-42579*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIRECT NEAR-IDENTITY CANONICAL TRANSFORMATIONS
David P. Stern Oct. 1970 10 p Presented at 12th Astrodyn. Conf., Greenbelt, Md., 26 – 27 Oct. 1970 Submitted for publication
(NASA-TM-X-65366; X-641-70-363) Avail: NTIS CSCL 12A

The transformation will be canonical provided it has a gradient operator in conjugate phase space, has arbitrary variables that may be regarded as the k-th order of a generating function, and there is a given vector depending on lower orders and their derivatives. Various choices of the generating function exist and some may be related to the conventional form or to Lie's form. Properties and uses for this representation are discussed. Author

N70-42592# Rome Air Development Center, Griffiss AFB, N.Y.
DISJUNCTIVE CANONICAL FORMS FOR GENERALIZATIONS OF THE COMPOSITE DEFINITE EVENT
S. Lawrence Kessler Aug. 1970 36 p refs
(AD-709882; RADC-TR-70-125) Avail: NTIS CSCL 12/1

Unique disjunctive canonical forms have been defined for several classes of events, all of which are generalizations of the composite definite event. A generalized composite event which includes all of these events, and more generally, any event containing concatenations of the free semigroup, A^*, has been introduced. Some necessary conditions for the generalized event to be canonically represented have been listed. It is shown, however, that these conditions are not sufficient to provide a unique form. Author (TAB)

N70-42594# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
COMPUTING ERROR BOUNDS WHEN THE TRUNCATION ERROR AND PROPAGATED ERROR ARE OF THE SAME ORDER Final Report
Charles L. Keller and Thomas E. Reeves Apr. 1970 224 p refs
(AD-709877; ARL-70-0069) Avail: NTIS CSCL 12/1

In a previous report, a program for computing bounds for the error in a numerical solution of a system of linear differential equations is given. Experimenting with this program led to two observations: (1) In some cases a much smaller integration step size than expected would be required for several steps at the start. (2) The bound was unduly large relative to the actual error for the integration steps at the start of the program. These features, while undesirable, are not critical, in general. The reason for this behavior is discussed in this report. A program is given which can overcome these undesirable features of the program. Also given is a complete account of the equations on which this program is based. Included in this report are instructions for the use of this program and the results of a number of sample problems. These results illustrate the reasons for this program and they enable the user to check his interpretation of the instructions for the use of the program. Author (TAB)

N70-42606 Rice Univ., Houston, Tex.
A PERTURBATION TREATMENT OF THE GENERAL ONE-DIMENSIONAL ANHARMONIC OSCILLATOR
Thomas Thorton Holloway, Jr. (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-19299

A method for calculating the energy levels associated with any smooth, single-minimum, one-dimensional potential is presented, and some interesting properties of the polynomials which occur in the energy expressions are shown. The reduced form of the wave equation for the general anharomic oscillator is solved by perturbation and the eigenvalues are expressed. All the polynomials necessary to evaluate the expression for Lambda through gamma to the minus 4th power were calculated and are presented. The P polynomials, when expressed as functions of $(n + 1/2)$, are either purely even or purely odd functions. A proof of this property is given. It is observed that all polynomials calculated have positive integral coefficients. An explicit formula proves this property for second order polynomials. The method is applied to the Lennard– Jones potential, and the energy levels are found to compare favorably with numerical integration calculations. The method is also applied to the Kratzer potential, and the results agree exactly with the expansion of the analytic result. Dissert. Abstr.

N70-42641# Midwest Research Inst., Kansas City, Mo.
TRANSFORMATION OF MONOTONE SEQUENCES
Jet Wimp Jun. 1970 13 p refs
(Contract F33615-69-C-1564)
(AD-710216; ARL-70-0098) Avail: NTIS CSCL 12/1

A method is presented for summing monotone sequences. The method is not regular, but a large class of convergent sequences is determined for which the transformed sequences are also convergent. TAB

N70-42644# Office of Research Analyses, Holloman AFB, N.Mex.
CURRENT STATUS OF RESEARCH ON NONLINEAR PHENOMENA
Harald A. Melkus Jun. 1970 58 p refs Presented at the Intern. Conf. on Nonlinear Oscillations (5th), Kiev, 25 Aug. – 5 Sep. 1969
(AD-709870; ORA-70-0009) Avail: NTIS CSCL 20/11

A short review of recent accomplishments in the general area of nonlinear oscillatory phenomena is presented. Scientists from 17 nations met in the USSR to exchange ideas on the theoretical background and practical tools that appear attractive in the analysis of nonlinear processes. Current status, recent progress, and evolving trends are discussed as reflected by the procendings of the 5th International Conference on Nonlinear Oscillations held in Kiev, August-September 1969. Author (TAB)

N70-42653# Pittsburgh Univ., Pa. Dept. of Physics.
SPACE-TIME STRUCTURE AND MEASUREMENT THEORY
J.-P. Antoine and Alan Gleit Jun. 1970 24 p Prepared in cooperation with Carnegie-Mellon Univ.
(Contract AT(30-1)-3829; Grant NSF GU-2056)
(NYO-3829-53) Avail: NTIS

A naive operational approach to measurement theory in a truly relativistic framework is given. Both experiments and states exist in finite regions of space-time. The causality structure of the underlying Minkowski space is described in terms of these. Author (NSA)

N70-42678# Brown Univ., Providence, R.I. Center for Dynamical Systems.
ASYMPTOTIC STABILITY CRITERIA FOR LINEAR SYSTEMS OF DIFFERENCE-DIFFERENTIAL EQUATIONS OF NEUTRAL TYPE AND THEIR DISCRETE ANALOGUES
Marshall Slemrod and E. F. Infante [1970] 36 p refs
(Contract N00014-67-A-0191-0009)
(AD-710423) Avail: NTIS CSCL 12/1

Electrical networks containing lossless transmission lines are often modeled by difference-differential equations of neutral type. The paper finds sufficient conditions for asymptotic stability for linear systems of these equations. Also given is a modification of the

direct method of Liapunov for difference equations. This method is applied to finding asymptotic stability criteria for the discrete analogues of the linear system of difference-differential equations. Author (TAB)

N70-42718 Delaware Univ., Newark.
DIGITAL SIMULATION USING POISSON TRANSFORM SEQUENCES
Michael Joseph Piovoso (Ph.D. Thesis) 1969 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-21970

The main purpose of this dissertation is to introduce an alternative discrete sequence to time samples or to the coefficients in an orthonormal expansion for use in digital simulation. This discrete time signal is generated by the Poisson transform sequence of a continuous time signal. The Poisson transform sequence, like time sampling, gives a sequence of convenient form for the digital simulation of linear analog systems and like coefficients in an orthonormal expansion, does not generate aliasing errors. In order to illustrate how the Poisson sequence may be applied, examples involving a third order Butterworth filter and an RLC network are presented. Dissert Abstr.

N70-42722# Washington Univ., Seattle. Dept. of Physics.
SIMPLE RELATIONS AMONG MULTIPLE SCATTERING AMPLITUDES
J. L. Friar and N. W. Dean (Vanderbilt Univ.) 1 Oct. 1969 8 p refs Supported in part by AEC
(RLO-1388-572) Avail: NTIS

It is shown that the amplitudes for multiple scattering in nuclei with A < or = to 4 are related in a very simple way. It is therefore possible to calculate explicitly the contribution of double and triple scattering to the positive pion He-4 total cross section if the positive or negative pion, He-3 and positive or negative pion, proton total cross sections are also known without the need of fitting the differential cross sections. These contributions contain information about Regge cuts as well as the nuclear structure. Author (NSA)

N70-42747# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.
SOME GENERALIZATION OF SIMPLE WAVES. SIMILARITY SOLUTIONS. HELICOPTER STUDY, 2
Shiang-yu Lee Aug. 1970 13 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-710403; Themis-UI-23) Avail: NTIS CSCL 12/1

By adopting the concept of similarity transformations, a class of boundary value problems of hyperbolic partial differential equations can be solved including the classical simple wave solutions as special cases. The new technique may find important applications in engineering problems of fluid and solid dynamics. Author (TAB)

N70-42812*# Texas A&M Univ., College Station. Remote Sensing Center.
DISCUSSION OF THE LEAST SQUARES TECHNIQUE AND DEVELOPMENT OF A CURVE FITTING SUBROUTINE
T. A. Eppes Sep. 1969 29 p refs
(Grant NGL-44-001-001)
(NASA-CR-110868; RSC-04) Avail: NTIS CSCL 12A

Backscatter data are commonly used for graphs of scattering coefficient as a function of incidence angle, but for some applications it is sufficient to classify these graphs according to a characterizing factor such as slope of curve, etc. Previously, this involved the use of a manual technique of estimating the appropriate equation variable to fit the experimental data. The material presented describes a computer technique which improves the degree of fit and is readily adaptable to scatterometer data analysis techniques. D.L.G.

N70-42901# Oklahoma Univ., Norman. Dept. of Mathematics.
THE DISTANCE BETWEEN ZEROS OF A SOLUTION OF A SECOND ORDER DIFFERENTIAL EQUATION Final Report, 2 Jun.–1 Aug. 1970
Stanley B. Eliason 31 Jul. 1970 8 p refs
(Contract DA-ARO(D)-31-124-70-G83)
(AD-710422; AROD-8549-3-M) Avail: NTIS CSCL 12/1

In the theory of second order ordinary linear homogeneous differential equations of the type (y double prime) + (lambda)p(x)y = 0 having variable coefficient p, much work has been done involving distance between zeros of solutions and bounds for eigenvalues in terms of p relative to certain boundary conditions. The problem studied here is to establish analogs of this theory for nonlinear differential equations of the type (y double prime) + p(x)(y sup (2n+1)) = 0 where n is a positive integer. Author (TAB)

N70-42921*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
COMPLEX OPTIMIZATION AND ITS APPLICATION TO DISTRIBUTED-LUMPED-ACTIVE NETWORKS
L. P. Huelsman Mar. 1970 20 p refs
(Grant NGL-03-002-136)
(NASA-CR-110953) Avail: NTIS CSCL 12A

The use of a complex optimization technique which may be applied to the synthesis of distributed-lumped-active networks, i.e., networks comprised of elements which are distributed, lumped, or active in nature is described. A constraint procedure which may be used to insure the realizability of the network parameters and which avoids local optima in the optimization process is discussed. Several examples of the application of the process to specific network configurations are given. Author

N70-42927# RAND Corp., Santa Monica, Calif.
A NOTE ON MARGINAL ALLOCATION IN MULTIPLE-SERVER SERVICE SYSTEMS
Alan J. Rolfe Jun. 1970 8 p refs
(AD-708927; P-4393) Avail: NTIS CSCL 12/2

The paper discusses mathematical models of a service system, composed of N facilities, to expedite service to customers. TAB

N70-42947 Michigan State Univ., East Lansing.
STATE SPACE AXIOMS AND STATE DESCRIPTIONS IN CANONICAL FORM
Izzet Cem Goknar (Ph.D. Thesis) 1969 194 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-20864

Starting with improved versions of Zadeh's state axioms, the necessity of another minor modification is shown and the different axiom sets are discussed. With the axioms modified, the important concept of equivalence classes of inputs (the major tool of the behavioral approach) is used to investigate the properties of reduced and half reduced state descriptions. Then, the essential properties that state descriptions acquire when the system is linear and/or time invariant are examined, and state equations in canonical form are obtained for a large class of distributed systems. The problem of approximating more general systems, with only minor restrictions on the input space by systems that possess finite dimensional state spaces is given a solution. Dissert. Abstr.

N70-42963# California Univ., Los Angeles. Dept. of Mathematics.
A CONTROL THEORY BOLZA PROBLEM WITH INTERMEDIATE CONSTRAINTS
Weston Irwin Nathanson (Ph.D. Thesis) 1970 143 p refs
(Contract Nonr-233(76))
(AD-710420; Rept-70-1) Avail: NTIS CSCL 12/1

The paper is a discussion of the control theory analogue of a problem of Bolza in the calculus of variations where admissible arcs may be required to satisfy some intermediate constraints as

well as boundary conditions. This problem was first considered by Denbow who transformed it into a classical Bolza problem by looking at each stage defined by two consecutive intermediate constraints as being a classical Bolza problem and solving all stages simultaneously. This requires that each stage be of some positive duration, but it yields the necessary and sufficiency theorems associated with a minimizing arc for the Bolza problem of that time. Author (TAB)

N70-42965# Illinois Univ., Urbana. Coordinated Science Lab.
SINGULAR PERTURBATIONS OF A CLASS OF TWO POINT BOUNDARY VALUE PROBLEMS ARISING IN OPTIMAL CONTROL
Charles Robert Hadlock Jul. 1970 127 p refs
(Contract DAAB07-67-C-0199)
(AD-709770; R-481) Avail: NTIS CSCL 12/1

Sufficient conditions are established for the existence of a solution to the system dx/dt = f(x,v,y,w,t,u) x(t sup o) = x sup o, dv/dt = p(x,v,y,w,t,u) v(T) = v sup T, u dy/dt = g(x,v,y,w,t,u) y(t sup o) = y sup o, udw/dt = q(x,v,y,w,t,u) w(T) = w sup T on (t sup o, T), where u is a small positive parameter and x, v, y, and w are vectors possibly of different dimensions, and for convergence of these solutions as u approaches 0 to a known, isolated solution of the degenerate system dx/dt = f(x,v,y,w,t,0) x(t sup o) = x sup o, dv/dt = p(x,v,y,w,t,0) v(T) = v sup T, 0 = g(x,v,y,w,t,0), 0 = q(x,v,y,w,t,0). The behavior of such solutions near the endpoints t sup o and T is examined (boundary layer behavior). An asymptotic expansion technique of Vasileva is extended to this class of problems in a formal way, with a discussion of the computational aspects. Problems of this type are shown to arise in a fixed time free endpoint problem of optimal control, and a design based on the method is carried out for a tension regulator in a strip winding process for a rolling mill plant. Author (TAB)

N70-42970# Illinois Univ., Urbana. Coordinated Science Lab.
SERIES NASH SOLUTION OF TWO-PERSON NONZERO-SUM LINEAR-QUADRATIC DIFFERENTIAL GAMES
J. B. Cruz, Jr. and C. I. Chen Jul. 1970 29 p refs Submitted for publication
(Contract DAAB07-67-C-0199; Grants AF-AFOSR-1579-68; NSF GK-3893)
(AD-710088; R-482; UILU-ENG-70-227; AFOSR-70-2196TR) Avail: NTIS CSCL 12/2

It is well-known that the Nash equilibrium solution of a two-person nonzero-sum linear differential game with a quadratic cost function can be expressed in terms of the solution of coupled generalized Riccati-type matrix differential equations. For high order games the numerical determination of the solution of the nonlinear coupled equations may be difficult or even not possible when the application dictates the use of small memory computers. In this paper a series solution is suggested by means of a parameter imbedding method. Instead of solving a high order Riccati matrix equation a lower order matrix Riccati equation corresponding to a zero-sum game is solved. In addition, lower order linear equations have to be solved. These solutions to lower order equations are the coefficients of the series solution for the nonzero-sum game. Cost functions corresponding to truncated solutions are compared with those for exact Nash equilibrium solutions. Author (TAB)

N70-43023# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
SIZE-BIASED SAMPLING
R. L. Scheaffer Apr. 1970 26 p refs
(Contract DAHC04-68-C-0002; Proj. THEMIS)
(AD-710223; THEMIS-UF-TR-36; AROD-T-1-50-RT) Avail: NTIS CSCL 12/1

Sampling components which are operating in a system at a fixed time and then observing the lifelengths of these components leads one to a length-biased sample. This concept is generalized to size-biased sampling, which often occurs when sampling multi-sized units such as particles. Estimators of average unit size are presented for the cases in which the underlying size distribution is gamma, Weibull or log-normal. These estimators, when specialized to the length-biased case, are shown to be improvements over some estimators already presented in the literature. Also, the problem of estimating mean life from backward recurrence times is discussed and some improved estimators are presented. Author (TAB)

N70-43025# California Univ., Los Angeles. School of Engineering and Applied Science.
RECURSIVE FILTERING FOR SYSTEMS WITH SMALL BUT NONNEGLIGIBLE NONLINEARITIES
H. W. Sorenson and A. R. Stubberud Jul. 1970 20 p refs
(Grant AF-AFOSR-699-67)
(AD-709226; AFOSR-70-1966TR) Avail: NTIS CSCL 12A

Linear estimation theory has been applied extensively to nonlinear systems by assuming that perturbations from a reference solution can be described by linear equations. As long as the second order (and higher) terms in the perturbation equations are negligible, linear estimation techniques have been found to yield satisfactory response. Many examples have been encountered in which the linear theory is not satisfactory, however, and it is to this situation that attention is directed here. Time-discrete systems in which the second order effects are small but nonnegligible are considered. Recursion relations for the conditional mean and covariance are developed. While these relations yield approximations to the true values of these moments, they are superior to the approximations provided by applying linear theory to a nonlinear system. Some results for a simple system are presented in which the response from linear and nonlinear filters is compared. Author (TAB)

N70-43055*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
ON THE DESIGN OF OPTIMAL CONSTRAINED DYNAMIC COMPENSATORS FOR LINEAR CONSTANT SYSTEMS
Timothy L. Johnson and Michael Athans Mar. 1970 15 p refs Submitted for publication
(Grants NGL-22-009-124; AF-AFOSR-1724-69; NSF GK-14152)
(NASA-CR-113892; AD-706115; AFOSR-70-1249TR) Avail: NTIS CSCL 12A

The paper deals with the design of linear time-invariant dynamic compensators of fixed dimensionality (s) which are to be used for the regulation of an n-th order linear time-invariant plant. A modified quadratic cost criterion is employed in which a quadratic penalty on the system state as well as all compensator gains is used; the effects of the initial state are averaged out. The optimal compensator gains are specified by a set of simultaneous non-linear matrix algebraic equations. The numberical solution of these equations would specify the gain-matrices of the dynamic compensator. The proposed method may prove useful in the design of low-order (s) compensators for high-order (n) plants that have few (r) outputs, so that the dimension of the compensator is less than that obtained through the use of the associated Kalman-Bucy filter (n) or Luenberger observer (n-r). Author (TAB)

N70-43056# Center for Naval Analyses, Arlington, Va.
THE EIGENVECTORS OF A REAL SYMMETRIC MATRIX ARE ASYMPTOTICALLY STABLE FOR SOME DIFFERENTIAL EQUATION
Stephen H. Saperstone Jul. 1970 25 p refs *Its* Profess. Paper No. 38
(AD-708502) Avail: NTIS CSCL 12/1

Let A be a real symmetric n x n matrix. For each real unit vector x one computes numbers mu = mu(x) and sigma = sigma(x), which have the property that (mu + sigma, mu - sigma) contains an eigenvalue of A. An autonomous differential equation is established, dependent on A, which admits asymptotically stable solutions of the form, x = eigenvector of A. This is achieved by

noting sigma squared (x) is a Liapunov function, and tends monotonically to zero along solutions of the differential equation. The set of critical points of sigma squared (x) are shown to comprise a finite union of products of spheres. Author (TAB)

N70-43061# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
LIMIT LAWS FOR EXTREME ORDER STATISTICS FROM STRONG-MIXING PROCESSES
Roy E. Welsch Apr. 1970 21 p refs Prepared in cooperation with Stanford Univ.
(Contracts DA-31-124-ARO(D)-209; N00014-67-A-0112-0015)
(AD-710228; TR-52; AROD-968-59-M) Avail: NTIS CSCL 12/1

The paper characterizes the possible limit laws for a sequence of normalized extreme order statistics (maximum, second maximum, etc.) from a stationary strong-mixing sequence of random variables. It extends the work of Loynes who considered only the maximum process. The maximum process leads to limit laws that are the same three types that occur when the underlying process is a sequence of independent random variables. The results presented here show that the possible limit laws for the k-th maximum process (k>1) from a strong-mixing sequence form a larger class than can occur in the independent case. Author (TAB)

N70-43068# Purdue Univ., Lafayette, Ind. Dept. of Computer Science.
NUMERICAL ANALYSIS Final Report, 1 Jul. – 30 Aug. 1969
John R. Rice 1 Sep. 1970 12 p
(Contract N00014-67-A-0226-0011)
(AD-710431; CSD-TR-49) Avail: NTIS CSCL 12/1

The report summarizes the activities supported in full or part under the contract. The activities are broken into three major areas: The Special Year in Numerical Analysis, The Mathematical Software Symposium, and Research. Author (TAB)

N70-43069# Nottingham Univ. (England). Dept. of Mathematics.
THEORY OF NUMBERS Final Technical Report, Apr. 1969 – Jun. 1970
H. Halberstam, H. E. Richert, J. W. Porter, R. C. Vaughan, and D. R. Woodall Jun. 1970 90 p refs
(Contract DAJA37-69-C-1081)
(AD-710334; ARDG-(E)-E-1339) Avail: NTIS CSCL 12/1

The collection of papers reports work done under contract on the theory of numbers, particularly to extend sieve methods to reducible polynomials and the distribution of primes in arithmetic progressions to othr sequences. The work in combinatorial mathematics is directed toward combinational designs. Titles of the seven papers are: Mean Values Theorems for a Class of Arithmetic Functions; Sieve Methods - The Small Sieve; Sums of k TH Order Divisor Functions Extended Over the Primes; On the Problem of Erdos, Straus and Schinzel; On the Addition of Sequences of Integers; Thrackles and Deadlock; and, Distances Realized by Sets Covering the Plane. Author (TAB)

N70-43071*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
THE SYNTHESIS OF OPTIMAL CONTROLS FOR LINEAR PROBLEMS WITH RETARDED CONTROLS
H. T. Banks, Marc Q. Jacobs, and M. R. Latina [1970] 96 p refs
(Grants NGL-40-002-015; AF-AFOSR-693-67B; NSF GP-15132)
(NASA-CR-113946) Avail: NTIS CSCL 12A

Optimization problems involving linear systems with retardations in the controls are studied in a systematic way. Some physical motivations for the problems are discussed. The topics covered are: controllability, existence and uniqueness of the optimal control, sufficient conditions, techniques of synthesis, dynamic programming. A number of solved examples are presented. Author

N70-43078# Utrecht State Univ. (Netherlands).
GENERALISED SEQUENCE SPACES [GEGENERALISEERDE RIJENRUIMTEN]
Nicole Leonie Jean Marie De Grande-De Kimpe (Ph.D. Thesis) 1970 104 p refs In DUTCH; ENGLISH summary
Avail: NTIS

The theory of perfect sequence spaces is generalized to the case where the sequences of vectors are taken in a locally convex space. The results are applied to the characterization of the topological properties of linear mappings between sequence spaces, etc. ESRO

N70-43091# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
GENERATION OF RANDOM TIME-SERIES THROUGH HYBRID COMPUTATION
P. E. Valisalo and A. H. Haddad May 1970 37 p refs
(Contract DAHC04-68-C-0002; Proj. Themis)
(AD-710225; THEMIS-UF-TR-35; AROD-T-1-53-RT) Avail: NTIS CSCL 12/1

In many engineering design problems it is possible to collect data of the environmental disturbances which are acting upon the systems. This data can be analyzed by determining its autocorrelation and probability density function. When seeking solutions through simulation it is desirable to be able to generate random time series having a predetermined autocorrelation and probability density. The paper describes a method to control both simultaneously. Author (TAB)

N70-43094# Southern Methodist Univ., Dallas, Tex. Information and Control Sciences Center.
TEST FOR POSITIVITY OF A PRESCRIBED POLYNOMIAL
Brian D. O. Anderson (Newcastle Univ., Australia) Feb. 1970 37 p refs
(Contract F44620-68-C-0023)
(AD-710309; AFOSR-70-1728TR) Avail: NTIS CSCL 12/1

The prime purpose of this paper is to outline tests which yield information about the number of real roots, and the positivity, of a prescribed polynomial. The Sturm-Routh test is reviewed and use of a Routh array for executing a Strum test is explained; a Markov test based on Markov parameters is reviewed, and a modified version of a test due to Fujiwara is given, this with its relation to the Markov parameter test. Finally, a test in the language of linear system theory is given, and a relation is noted between this and the Fujiwara test. Author (TAB)

N70-43160# California Univ., Berkeley. Operations Research Center.
ENUMERATIVE ALGORITHMS FOR SOLVING A CLASS OF NETWORK SYNTHESIS PROBLEMS
Robert D. Sanderson Apr. 1970 146 p refs
(Contracts N00014-69-A-0200-1010; DA-31-124-ARO(D)-331; Grants NSF GP-15473; NSF GK-1684)
(AD-710417; ORC-70-11; AROD-5307-47-M) Avail: NTIS CSCL 12/2

A class of network flow problems having a combinatorial nature is defined. A network is synthesized by including exactly one directed arc from each of several disjoint subsets of possible arcs. All candidate arcs in a particular subset connect the same pair of nodes, and associated with each arc are five parameters: a cost of inclusion, unit cost of flow, lower and upper limits on flow, and direction of positive flow. When a network is synthesized, a least cost feasible flow is computed. The objective of the problem is to synthesize the network for which the total cost--costs of inclusion plus costs of flow--is least. In certain special cases the problem reduces to a linear minimum cost flow problem, but more frequently an enumerative technique is required. Branch-and-bound and implicit enumeration algorithms are formulated and compared. The algorithms are specialized for three applications: plant location

problems, cost-time critical path scheduling with nonconvex costs, and critical path scheduling under disjunctive constraints. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N70-42028*# Environmental Science Services Administration, Silver Spring, Md. Space Operations Support Div.
FREQUENCY AND DURATION OF THUNDERSTORMS AT CAPE KENNEDY. PART 2: APPLICATION TO FORECASTING
Charles J. Neumann May 1970 66 p refs Sponsored by NASA
(NASA-CR-114120; ESSA-TM-WBTM-SOS-6-Pt-2) Avail: NTIS CSCL 04B

An objective forecast scheme for estimating the probability of thunderstorm activity at or in the immediate vicinity of the Kennedy Space Center, Florida is presented. Three predictors form the basis of the probability determination. The principal predictor is the observed 3000-foot wind direction taken daily at 1200 GMT at the Space Center. Of secondary importance, but still significant, is the concurrent 3,000 foot wind speed. The third predictor, time, is inherent in the forecast scheme since a separate set of probabilities is presented for each of the 31 5 day periods comprising the May through September thunderstorm season. The probabilities were found to range from near zero with northeasterly winds in May to near 90 percent with 14 knot southwesterly winds in July and August. Provision is made for stating the probabilities for the entire afternoon or over portions of the afternoon. Author

N70-42049*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GUIDE TO THE USE OF DATA COLLECTED BY THE NASA NP3A AIRCRAFT IN THE BOMEX, 2-10 JUNE 1969
Victor S. Whitehead Sep. 1970 40 p
(NASA-TM-X-58049) Avail: NTIS CSCL 04B

This report provides potential users of the data with the information required to select and use that data in a knowledgeable and effective manner. The systems aboard the aircraft and the format of their archived output are described. The ground tracks of the aircraft are depicted, and logs manually taken aboard the aircraft are provided. Author

N70-42077# Research Inst. of National Defence Stockholm (Sweden).
RADAR ANGELS AND THEIR RELATIONSHIP TO METEOROLOGICAL FACTORS Final Report
Hans Ottersten Apr. 1970 37 p refs *Its* FOA Rept. Vol. 4, no. 2
(AD-707863; FOA-3-B-3016-60) Avail: NTIS CSCL 4/2

From a year-long study of radar angels, carried out near Stockholm, Sweden, with a 10-cm vertically-pointing pulse radar, tropograms, or time-height records of angel activity, have been obtained together with information on meteorological parameters. Amplitude records of individual angel echoes have also been studied. Various types of radar angels are exemplified, and the seasonal variation and the height distribution of the angel activity is reviewed. Theoretical approaches to meteorological explanations of angel phenomena are discussed in terms of the consequences for the tropospheric refractive-index field. The statistical relationship between radar angels and meteorological parameters is presented, and explanations of the angel phenomena are offered. Layer angels, which are persistent, diffuse, layer-type echoes, occur due to backscattering from clear-air refractive-index perturbations associated with free convection, or with turbulent mixing induced by wind shear in zones of enhanced static stability. Dot angels, which are short-duration, coherent echoes from apparent point targets, are difficult to explain as reflections from invisible meteorological targets and are mainly caused by insects and birds. Author (TAB)

N70-42083# Defence Scientific Information Service, Ottawa (Ontario).
CUMULUS CLOUD AND CLOUDBURST PRECIPITATION ON WARM FRONTS IN THE ARCTIC
L. A. Gavrilova May 1970 5 p Transl. into ENGLISH from Probl. Arktiki Antarktiki, Sb. Statei (Leningrad), no. 31, 1969 p 77–78
(AD-707633; T-540-R) Avail: NTIS CSCL 4/2

Frontal cloud research was carried out during the summers of 1963 to 1965 by an airborne expedition of the Arctic and Antarctic Institute, using a specially equipped IL-14 Flying Laboratory aircraft. Flights made in the warm front zone showed in a number of cases that stratus cloud (As and Ns) changed, at a height of 1.5-2 km, into thick cumulus cloud of the type Cu Cong. Cb, the base of which was the upper boundary of the As and Ns. Examples of this were observed during flights over the Kara and Laptev Seas from the coast to latitude 80N. Flying in the frontal cloud was rendered somewhat difficult by intense bumpiness, icing and thunderstorm conditions. Analysis of the synoptic charts showed that meteorological fronts with such cloudiness are for the most part located on the periphery of extensive high blocking anticyclones, or in nearly stationary cyclones blocked from northward motion by anticyclones. Author (TAB)

N70-42134 National Lending Library for Science and Technology, Boston Spa (England).
OZONE AND METEOROLOGICAL FORECASTING
J. P. Bancarel et al 24 Jun. 1970 12 p refs Transl. into ENGLISH from Ann. Geoph. (Paris), no. 25, 1969 p 195–201
(NLL-M-9195-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The properties of ozone as an atmospheric tracer, and the vertical distribution of ozone were studied by soundings. The soundings were classified according to the partial pressure of ozone, and associated with a specific meteorological situation. The adaptations of the radiosonde and the receiver for measuring ozone are discussed. The results show a very small scattering of ozone in the lower atmosphere, and it is concluded that, with certain recommended improvements, the soundings will contribute to meteorological forecasting. F.O.S.

N70-42152# Massachusetts Inst. of Tech., Cambridge.
ATMOSPHERIC ACOUSTIC PROPAGATION STUDIES, PART B Final Report
Andrew Chung, Lee W. Dean, Theodore R. Madden May 1970 35 p
(Contract DA-31-124-ARO(D)-431)
(AD-709318; AROD-6086-3-EN) Avail: NTIS CSCL 20/1

The mechanical and electronic design of an infrasonic system that can be used to continuously study atmospheric acoustic propagation is described. The source radiates about 30 watts at a frequency of 13 to 14 cycles per second. The frequency of the source can be controlled to within plus or minus .01% which enables studies of the signal doppler shifts and amplitude variations to be made. The receiver uses a phase lock detector to monitor the doppler shifts and to increase the sensitivity. Transmission studies to date have been made out to distances of 90 kilometers down wind. Large amplitude variations as a function of time are commonly observed, but the doppler shift variations are less pronounced. Some of the observed variations are correlated with surface wind variations, but at the longer ranges the conditions at higher elevations become more important. With some improvement in the noise discrimination it should be possible to study acoustic wave propagation into the trospheric jet stream. Author (TAB)

N70-42192+ Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 100, NO. 2: ANNUAL ATMOSPHERIC VARIATIONS OVER THE NORTHERN HEMISPHERE BASED ON MEAN MONTHLY VARIATION CHARTS OF ATMOSPHERIC PRESSURE, TEMPERATURE, RELATIVE HUMIDITY, AND PRECIPITATION, AS WELL AS ABSOLUTE VALUES OF 500, 300, 100, 30, AND 10 mb LEVELS [METEOROLOGISCHE ABHANDLUNGEN. BAND 100, HEFT 2: DER JAEHRLICHE WITTERUNGSVERLAUF UEBER DER NORDHEMISPHAERE DARGESTELLT AN HAND DER MITTLEREN MONATLICHEN AENDERUNGSKARTEN DES LUFTDRUCKS, DER TEMPERATUR, DER RELATIVEN FEUCHTIGKEIT, DES NIEDERSCHLAGS SOWIE DER ABSOLUTEN TOPOGRAPHIEN DES 500, 300, 100, 30 UND 10 mb NIVEAUS]
Richard Scherhag et al 1970 182 p In GERMAN
Avail: NTIS

The mean Northern Hemispheric surface and upper air maps of monthly changes of pressure, temperature, relative humdity, and precipitation together with the contour changes of the 500, 300, 100, 30, and 10 mb surfaces, plotted by the grid point value differences calculated from daily maps, are presented. The data are derived from measurements made from 1931 to 1960 and contained in various meteorological publications. R.B.

N70-42197 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 104, NO. 11: RESULTS OF RADIOSONDE ASCENTS FROM THE BERLIN-TEMPELHOF STATION DURING NOVEMBER 1969. DAILY RESULTS, MONTHLY DATA, AND CLIMATOLOGICAL VALUES, AS WELL AS MEASUREMENT RESULTS OF SPECIAL ASCENTS [METEOROLOGISCHE ABHANDLUNGEN. BAND 104, HEFT 11: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN-TEMPELHOF IN JAHRE 1969. TAEGLICHE MESSRESULTATE, MONATLICHE BEARBEITUNG UND KLIMATOLOGISCHE WERTE, SOWIE MESSERGEBNISSE VON SPEZIALAUFSTIEGEN]
Eugen Pantzke, Richard Scherhag et al In GERMAN
Avail: NTIS

The detailed results of radiosonde ascents performed by the aerological station at Berlin-Tempelhof are presented. Using the data, monthly time cross sections of the averaged temperature and the zonal and meridional wind components at heights above 30 km were constructed. Extreme and mean values of the temperature, pressure, geopotential, wind data, refractivity, pseudopotential temperature, and sound velocity were extracted for all standard pressure surfaces, several height levels, the tropopause, and the freezing level. The data of the ozone ascents are given in tabular and graphical form. Author

N70-42231*# Chicago Univ., Ill. Dept. of Geophysical Sciences.
PATTERNS OF EQUIVALENT BLACKBODY TEMPERATURE AND REFLECTANCE OF MODEL CLOUDS COMPUTED BY CHANGING RADIOMETERS FIELD OF VIEW
Jaime J. Tecson May 1970 31 p refs *Its* SMRP Res. Paper No. 87
(Grant NGR-14-001-008)
(NASA-CR-114211) Avail: NTIS CSCL 04B

Based on computer simulation of simplified model clouds, discussions and analyses are made of radiance and reflectance characteristics in order to find the most suitable field of view. Various scan patterns of equivalent blackbody temperature and reflectance are presented by varying the instantaneous field of view, the width of cloud bands or diameter of circular clouds to be detected, the number of clouds, and some of their configurations. Author

N70-42246# Air Force Cambridge Research Labs., Bedford, Mass.
OPERATIONAL UTILIZATION OF THE AN/TPQ-11 CLOUD DETECTION RADAR
Wilbur H. Paulsen, Pio J. Petrocchi, and George McLean Jun. 1970 59 p refs *Its* AFCRL-IP-166
(AD-709364; AFCRL-70-0335) Avail: NTIS CSCL 4/2

Fifty-three AN/TPQ-11 Cloud Detection Radars were procured for Air Force use with most of these being installed at selected Air Force bases for operational use by the Air Weather Service detachments. As these sets are capable of furnishing a great deal of meteorological data that are not otherwise available, Air Weather Service requested AFCRL to conduct a study to determine the effect of geographical and seasonal variations on AN/TPQ-11 observations. Cloud height records obtained with the AN/TPQ-11 Cloud Detection Radar at eight widely separated Air Force Bases are analyzed for possible variations in interpretation that might be required as a function of geographical location an environment. The modes of operation of the sets necessary to obtain useful records with a maximum of information content are specified, and examples of records of the various types of meteorological situations are shown. Analyses of these records for their meteorological content are made, and a number of maintenance procedures are suggested that will assist in obtaining high quality records for analysis. Author (TAB)

N70-42283# Naval Weather Service, Washington, D.C.
SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS, NORTH AMERICAN COASTAL MARINE AREAS. VOLUME 5: AREAS 14-15-16: FORT MYERS, APALACHICOLA, PENSACOLA
May 1970 482 p refs
(AD-709973) Avail: NTIS CSCL 4/2

The data contained in these tables were obtained from tape data Family 11 (TDF-11), Marine Surface observations. TDF-11 was primarily funded by the Naval Weather Service Command and selected by NWSED Asheville as the most comprehensive collection of marine surface observations from which to develop a series of coastal marine summaries. The areas discussed include Fort Myers, Apalachicola, and Pensacola, Florida. Author (TAB)

N70-42348*# California Univ., Los Angeles. Dept. of Meteorology.
NUMERICAL SIMULATION OF THE 1970 TO 1971 EOLE EXPERIMENT
Fedor Mesinger and Yale Mintz 15 Jan. 1970 54 p refs
(Contract NAG-05-007-091)
(NASA-CR-110795; TR-4) Avail: NTIS CSCL 04B

In the Eole experiment, earth orbiting satellites track the motion of superpressure balloons and communicate with sensors on them to gather data on the wind, temperature, pressure, and geopotential of the air at the position of each balloon. The anticipated trajectories of the balloons for a 130 day period are studied by numerical simulation of the general circulation of the global atmosphere. R.B.

N70-42381*# California Univ., Los Angeles. Dept. of Meteorology.
NUMERICAL SIMULATION OF THE CLUSTERING OF CONSTANT-VOLUME BALLOONS IN THE GLOBAL DOMAIN
Fedor Mesinger and Yale Mintz 1 Feb. 1970 37 p refs
(Grants NGR-05-007-091; NSF GA-1470)
(NASA-CR-110787; TR-5) Avail: NTIS CSCL 04B

The results of the numerical simulations of the global distribution of balloons in the upper and lower troposphere are presented, and their space-time distributions are shown by several different statistical representations. The most important change from previous simulations is considered to be the addition of water vapor as a time-dependent variable, with parameterization of cumulus convection, giving a more realistic circulation in the tropical region. It was found that starting with an ideal distribution of balloons randomly spaced over the globe, the balloons in the upper

troposphere rapidly left the tropical region. In the southern region the clustering centered at 45 deg latitude, and in the northern region the balloons became rather uniformly distributed poleward of 40 deg latitude, with a depletion between 30 and 40 deg. In the lower troposphere there was a rapid loss of balloons by collision with the earth's surface. Many of the remaining balloons collected along the intertropical convergence zone with a large cluster over south central Brazil. N.E.N.

N70-42362*# Chicago Univ., Ill. Satellite and Mesometeorology Research Project.
LUBBOCK TORNADOES OF 11 MAY 1970
Tetsuya Theodore Fujita Jul. 1970 24 p refs Submitted for publication
(Grants NGR-14-001-008; ESSA-E-198-68(G))
(NASA-CR-110786; SMRP-RP-88) Avail: NTIS CSCL 04B

Visual, satellite, and weather station data on the Lubbock, Texas tornadoes of 11 May 1970 are presented. Recommendations are made for observation and warning of possible destructive storms. The data indicate that destructive tornadoes can be identified by the tornado-bearing hook echoes appearing on radar screens. R.B.

N70-42403 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 113, NO. 1: BERLIN READINGS: DIGITAL AND ANALOG RESULTS FROM THE CENTRAL MEASUREMENT REGISTRATION FACILITY AND OTHER INSTRUMENTS FOR 1970 Quarterly Report, Part 1 [METEOROLOGISCHE ABHANDLUNGEN. BAND 113, HEFT 1: BERLINER MESSWERTE: DIGITALE UND ANALOGUE ERGEBNISSE DER ZENTRALEN MESSWERTREGISTRIERANLAGE UND WEITERER INSTRUMENTE FUER DAS JAHR 1970. TEIL 1, 1. VIERTEJAHR]
Richard Scherhag, Erich Wedler et al 1970 351 p refs In GERMAN
(QR-1-Pt-3) Avail: NTIS

Digital and analog measurements on atmospheric radiation, electric fields, back radiation, and global radiation were corrected for dew and frozen fog formation as well as for precipitation caused errors. Climatological data are given for the period January through March 1970. Transl. by R.B.

N70-42408+ Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 112, NO. 4: RESULTS OF THE SYNOPTIC SERVICES FOR 1970. DAILY WEATHER CHARTS (GROUND, 500 mb, 300 mb) AND SMALLER SCIENTIFIC STUDIES FOR APRIL [METEOROLOGISCHE ABHANDLUNGEN. BAND 112, HEFT 4: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1970. TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb) UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE]
Manfred Geb, Leopold Klauser, and Richard Scherhag 1970 197 p refs In GERMAN
Avail: NTIS

Synpotic weather maps for the Northern Hemisphere and for the intertropical convergence zone over Africa and the Atlantic Ocean are presented. Median climatological values, precipitation and temperature measurements, and radioactivity determination in the vicinity of Berlin, Germany are included for April 1970. Transl. by R.B.

N70-42422# Institut Royal Meteorologique de Belgique, Brussels. Institut d'Hygiene et d'Epidemiologie.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Jan. 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Janvier 1970]
1970 28 p In FRENCH and DUTCH
Avail: NTIS

Tables of sulfur dioxide and smoke quantity (air pollution) measured at different weather stations in Belgium during January 1970 are presented. A brief description is given of the air sampling apparatus. ESRO

N70-42425# Naval Weather Service, Washington, D.C.
SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS. NORTH AMERICAN COASTAL MARINE AREAS. VOLUME 9: AREAS 27-29, EUREKA, NORTH BEND, AND NEWPORT
May 1970 482 p
(AD-709939) Avail: NTIS CSCL 4/2

The data contained in these tables were obtained from tape data Family 11 (TDF-11), Marine Surface observations. TDF-11 was primarily funded by the Naval Weather Service Command and selected by NWSED Asheville as the most comprehensive collection of marine surface observations from which to develop a series of coastal marine summaries. The areas discussed include Eureka, California, and Newport and North Bend, Oregon. Author (TAB)

N70-42426+ Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 112, NO. 5: RESULTS OF THE SYNOPTIC SERVICES FOR 1970. DAILY WEATHER CHARTS (GROUND, 500 mb, 300 mb) AND SMALLER SCIENTIFIC STUDIES FOR MAY [METEOROLOGISCHE ABHANDLUNGEN. BAND 112, HEFT 5: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1970, MAI. TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb) UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE]
Manfred Geb, Leopold Klauser, Richard Scherhag et al 1970 172 p refs In GERMAN
(QR-5) Avail: NTIS

Synoptic weather maps for the Northern Hemisphere constructed from measurements of ground, 500 mb and 300 mb levels during May are given. Median climatological values, precipitation and temperature measurements, and radioactivity determination in the vicinity of Berlin, Germany are given for May 1970. Transl. by R.B.

N70-42436+ Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 104, NO. 10: RESULTS OF RADIOSONDE ASCENTS FROM THE BERLIN-TEMPELHOF STATION OF THE INSTITUTE FOR METEOROLOGY AND GEOPHYSICS OF THE FREE UNIVERSITY, BERLIN, DURING OCTOBER 1969. DAILY RESULTS, MONTHLY DATA, AND CLIMATOLOGICAL VALUES, AS WELL AS MEASUREMENT RESULTS OF SPECIAL ASCENTS [METEOROLOGISCHE ABHANDLUNGEN. BAND 104, HEFT 10: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN-TEMPELHOF DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1969, OKTOBER. TAEGLICHE MESSRESULTATE, MONATLICHE BEARBEITUNG UND KLIMATOLOGISCHE WERTE, SOWIE MESSERGEBNISSE VON SPEZIALUFSTIEGEN]
Eugen Pantzke, Richard Scherhag et al 1970 184 p refs In GERMAN; ENGLISH summary
(QR-10) Avail: NTIS

The detailed results of radiosonde ascents performed at the aerological station at Berlin-Tempelhof are presented. Using the data, monthly mean time cross sections of the averaged temperature and the zonal and meridional wind components at heights above 30 km were constructed. Extreme and mean values of the temperature, pressure, geopotential, wind data, refractive, pseudopotential temperature, and sound velocity were extracted for

standard pressure surfaces, several height levels, the tropopause, and the freezing level. The data of the ozone ascents are given in tabular and graphical form. Author

N70-42439 Michigan Univ., Ann Arbor.
LAKE EFFECTS ON AIR POLLUTION DISPERSION
Lars Erik Olsson (Ph.D. Thesis) 1969 238 p
Avail: Univ. Microfilms; HC $10.80/Microfilm $3.00 Order No. 69-18074

Local wind regimes induced by a lake or a shoreline have a major influence on air pollution dispersion. Pressure differences due to differential heating of the air, e.g., those due to differences in surface characteristics between land and lake, are the driving forces of lake and land breeze circulations. Differences in roughness between land and lake surfaces will cause wind shear and aerodynamic downwash effects at a shoreline. Stability changes in the air result from differences in surface temperature and roughness between land and lake, e.g., when warm unstable air moves out over a cool lake, a temperature inversion will develop near the surface, thus creating poor dispersion and trapping of pollutants. Fumigation will occur as this stable layer is broken up when the air moves across a shoreline and advances inland. A number of these lake influences have been examined in detail on two separate occasions. Dissert. Abstr.

N70-42453# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, May 1969 [OBSERVATIONS SYNOPTIQUES Bulletin Mensuel, Mai 1969]
1970 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in May 1969 are presented. ESRO

N70-42456# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Jun. 1969 [OBSERVATIONS SYNOPTIQUES Bulletin Mensuel, Juin 1969]
1970 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in Jne 1969 are presented. ESRO

N70-42462# Secretariat General a l'Aviation Civile, Paris (France). Direction de la Meteorologie Nationale.
NOTE ON THE STRUCTURE OF CERTAIN CLOUD FORMATIONS ASSOCIATED WITH THE JET STREAM [NOTE SUR LA STRUCTURE DE CERTAINES FORMATIONS NUAGEUSES ASSOCIEES AU COURANT-JET]
H. Gland and A. Noyalet Aug. 1970 27 p refs In FRENCH
(Its Monographie No. 77
Avail: NTIS

An attempt to synthesize the possibilities offered by the utilization of meteorological satellite photography to reveal the presence of and determine the position of jet streams is presented. The structure of clouds associated with strong winds is discussed; two formations are particularly useful in specifying the position of the jet stream axes. These formations appear on the photographs in the following configurations: (1) large cirriform sheets clearly defined on their polar side by a slightly curved anticyclonic or quasi-rectilinear border, and (2) long narrow cirriform ribbons several kilometers in width and several hundred kilometers in length. Specific examples of application are discussed with accompanying photographs. Transl. by P.A.B.

N70-42463# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Mar. 1969 [OBSERVATIONS SYNOPTIQUES Bulletin Mensuel, Mars 1969]
1970 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in March 1969 are presented. ESRO

N70-42465# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Jul. 1970 [OBSERVATIONS CLIMATOLOGIQUES Bulletin Mensuel, Juillet 1970]
1970 16 p In FRENCH and DUTCH
Avail: NTIS

Climatological data derived from observations made at different Belgian weather stations during July 1970 are given. ESRO

N70-42493# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Apr. 1969 [OBSERVATIONS SYNOPTIQUES Bulletin Mensuel, April 1969]
1970 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in April 1969 are presented. ESRO

N70-42540# Meteorological Office (Gt. Brit.)
THE DYNAMICS OF THE STRATOSPHERE, MESOSPHERE AND LOWER THERMOSPHERE
R. J. Murgatroyd Paris ESRO Sep. 1968 81 p refs
(ESRO-SP-30) Avail: NTIS

Starting with the basic dynamical equations of meteorology, the theoretical background of the principal features of the atmospheric motions observed in the stratosphere, mesosphere, and lower thermosphere is discussed. The general circulation of each region is examined in terms of its driving forces, transfer of heat, momentum and tracer substances, and the energetics and roles of the mean and eddy motions. The mechanics of the different scales of motion, in particular those of the planetary waves, tides, and gravity waves, are outlined separately. Author (ESRO)

N70-42546# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Jan. 1969 [OBSERVATIONS SYNOPTIQUES Bulletin Mensuel, Janvier 1969]
1970 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in January 1969 are presented. ESRO

N70-42558 National Lending Library for Science and Technology, Boston Spa (England)
DISCUSSION OF THE EXPERIENCE GAINED FROM OBSERVATION POSTS FOR MEASURING THE CHEMICAL COMPOSITION OF ATMOSPHERIC AIR IN TOWNS
I. A. Jankovskij 29 May 1970 12 p ref Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 234, 1968 p 118–124 (NLL-M-9140-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The experiences of local departments of the hydrometeorological service in studying air pollution are summarized with emphasis on research organization. The most effective way of choosing sampling sites is by a preliminary survey of town air with specially equipped vehicles, and long-term data of the wind regime. The equipment used for taking air samples is discussed. It is recommended that meteorological observations be recorded at all sampling sites except those near meteorological stations. F.O.S.

N70-42597 National Lending Library for Science and Technology, Boston Spa (England).
THE PHYSICAL PRINCIPLES OF THE CALCULATION OF DIFFUSION OF INDUSTRIAL WASTE IN THE ATMOSPHERE
M. E. Berljand et al 29 May 1970 34 p refs Transl. into ENGLISH from Glav. Geof. Obs., Vyp. (Leningrad), v. 234, 1968 p 3–27
(NLL-M-9163-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

The basic principles underlying diffusion calculations are discussed, and the resulting equations are given. The predominant and anomalous weather conditions affecting diffusion, the impurity concentration from factories, and the spacing of factories from each other and from residential areas are considered. Experimental testing of the theoretical calculations are reviewed, and it is concluded that the theoretical considerations are substantially confirmed. N.E.N.

N70-42616# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Jun. 1970 [OBSERVATIONS CLIMATOLOGIQUES Bulletin Mensuel, Juin 1970]
1970 16 p In FRENCH and DUTCH
Avail: NTIS

Climatological data derived from observations made at different Belgian weather stations during June 1970 are given. ESRO

N70-42628*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENTS OF MICROWAVE EMISSION FROM A FOAM COVERED, WIND DRIVEN SEA
W. Nordberg, J. Conaway, Duncan B. Ross, and T. Wilheit Oct. 1970 26 p refs Submitted for publication
(NASA-TM-X-65368; X-650-70-384) Avail: NTIS CSCL 04B

Measurements were made from aircraft of the 1.55 cm microwave emission from the North Sea and North Atlantic at surface wind speeds ranging from less than 5 to 25/msec. Brightness temperatures in the nadir direction increased almost linearly with wind speed from 7 msec to 25/msec at a rate of about 1.2 C per meter/sec. At 70 deg from nadir the rate was 1.8 C per meter/sec. This increase was directly proportional to the occurrence of white water on the sea surface. At wind speeds less than 7/msec, essentially no white water was observed and brightness temperatures in the nadir direction were about 120 K; at wind speeds of 25/msec white water cover was on the order of 30 percent and average brightness temperature at nadir were about 142 K. Maximum brightness temperatures for foam patches large enough to fill the entire radiometer beam were 220 K. Author

N70-42633# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
CURRENT HIGH ALTITUDE OBSERVATIONS: INVESTIGATION AND POSSIBLE IMPROVEMENT
M. A. Alaka and R. C. Elvander Jul. 1970 29 p refs
(ESSA-TM-WBTM-TDL-36) Avail: NTIS

An estimate is made of the capability of current Rawin observations at 20 mb to measure differences in the strength of the zonal wind between two points separated by a given time or space interval. It is found that the random errors associated with these observations are high in comparison with the variability of the wind, especially during the summer months. A procedure for optimum smoothing is introduced whereby the weights given to the different observations used in the smoothing are determined by climatology, by the relative location of observations, and by their RMS random errors. The reduction by this procedure of the initial RMS errors of observations is determined for different network configurations. It is found that with a station separation of 1000 km, optimum smoothing reduces the RMS random error of the 20 mb zonal winds from their current level of 4.5 kt to 4.0 kt in January and 3.4 kt in July. The method of optimum interpolation is then used to determine the accuracy with which the field of zonal wind may be reconstructed from discrete observations. Two data acquisition schemes are described. Author

N70-42681*# Texas A&M Univ., College Station. Remote Sensing Center.
ON AIR TEMPERATURE FLUCTUATIONS IMMEDIATELY ABOVE A GLACIER SURFACE
Aylmer H. Thompson and Paul E. Carrara (Colo. Univ., Boulder) Apr. 1970 49 p refs
(Grant NGL-44-001-001)
(NASA-CR-110834; RSC-13) Avail: NTIS CSCL 04B

Measurements of air temperature fluctuations above the surface of the Juneau icefield of southeastern Alaska are discussed. The observations are represented as a series of profiles of the value of each parameter as a function of time. The data are to be used in designing remote sensing techniques for measuring meteorological parameters in surface layers of cold regions, especially of snow-covered surfaces. R.B.

N70-42694# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Feb. 1969 [OBSERVATIONS SYNOPTIQUES Bulletin Mensuel, Fevrier 1969]
1970 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in February 1969 are presented. ESRO

N70-42769# Institut Royal Meteorologique de Belgique, Brussels. Inst. d'Hygiene et d'Epidemiologie.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Dec. 1969 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Decembre 1969]
1969 28 p In FRENCH and DUTCH
Avail: NTIS

Tables of sulfur dioxide and smoke quantity (air pollution) measured at different weather stations in Belgium during December 1969 are presented. A brief description is given of the air sampling apparatus. ESRO

N70-42805 National Lending Library for Science and Technology, Boston Spa (England).
ON THE RELATIONSHIP BETWEEN SOURCES OF ATMOSPHERICS AND GEOGRAPHICAL FACTORS (IN THE CASE OF THE ARABIAN PENINSULA)
B. K. Inkov et al 29 May 1970 6 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 225, 1968 p 55–58
(NLL-M-9149-(5828.4F)) Avail: Natl. Lending Library Boston Spa, Engl.: 1 NLL photocopy coupon

The distribution of sources of atmospherics in the area of the Arabian peninsula is investigated as a function of thunderstorm activity. The area was divided into 11 zones and the number of recorded atmospherics with sources within a given zone was calculated. Comparative values were obtained by using normalizing factors equal to the ratio of the first zone to that of a given zone. The data show that thunderstorm activity over the coastal zone is 3 times that inland and 5 to 8 times that over the sea. The data also show a distinct annual variation of thunderstorm activity. R.B.

N70-42847*# Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.
ATTENUATION MEASUREMENTS IN ARTIFICIAL CLOUDS Final Technical Report

Darrell E. Burch, John D. Pembrook, and Elias Reisman Mar. 1970 76 p refs
(Contract NAS12-2124)
(NASA-CR-86343; Publ-U-4789) Avail: NTIS CSCL 04B

A CO2 laser operating at 10.6 microns and an He-Ne laser at 0.6328 microns were used as radiation sources to study the attenuation and near-forward scattering of artificial fogs. Scattering angles varied from 10 to 40 milliradians. Both water fogs and ice fogs were used. The experimental results compare favorably with calculated values based on Mie theory, both in the amount of scattered power and in its angular dependence. The extinction of both ice fogs and water fogs was measured at several wavelengths between 2.3 and 3.6 microns. A narrow window occurs at approximately 2.75 microns for water clouds and near 2.83 microns for ice clouds. The shapes of spectral curves of transmittance or of the extinction cross-section depend strongly on the particle-size distribution. Results indicate that significant errors exist in the published index of refraction values for ice near 2.8 microns. Simultaneous measurements of attenuation or scattering at two different wavelengths provide information on particle size distribution, influence of irregular shapes, and index of refraction which cannot be obtained from single-wavelength measurements. Author

N70-42899# Environmental Technical Applications Center (Air Force), Washington, D.C.
A SELECTED ANNOTATED BIBLIOGRAPHY OF ENVIRONMENTAL STUDIES OF POLAND
Alvin L. Smith, Jr., comp. Jun. 1970 62 p refs
(AD-709762; ETAC-TN-70-6) Avail: NTIS CSCL 4/2

The bibliography contains 153 references to environmental studies (1960-1969) concerning the Polish Peoples Republic (POLAND). Forty-three of the items reference translations of Polish articles and are placed separately in the text. Five previously published bibliographies on the same area are also referenced. Entries are entered alphabetically by author and a Subject Index is included. Author (TAB)

N70-42928# Naval Postgraduate School, Monterey, Calif.
A DIAGNOSTIC ANALYSIS OF THE 30 MAY 1967 SQUALL LINE IN CENTRAL OKLAHOMA
Randy J. Coleman (M.S. Thesis) Oct. 1969 127 p refs
(AD-706014) Avail: NTIS CSCL 4/2

A squall line is investigated during a 3-hour period of its mature life. Upper air data from the mesonetwork in Oklahoma at 1700, 1830, and 2000 GMT is used to determine vorticity, divergence, and vertical motion at 50 mb intervals. These and other fields are computed and investigated in detail, and possible problems associated with them are discussed. Two methods of computing vertical motion are described in detail. A mesoscale wave with a wavelength of approximately 90 n.m. is found at 700 mb. It moves faster than the wind at 700 mb but slower than the squall line. This wave is investigated in detail and is hypothesized to be the cause and the terminator of the squall line. The kinematic vertical motion technique presented appears to give realistic fields. Appendix B describes the problems found in the vorticity method and how it can be used on the synoptic scale. Author (TAB)

N70-42940# Institut Royal Meteorologique de Belgique, Brussels. Inst. d'Hygiene et d'Epidemiologie.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Nov. 1969 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Novembre 1969]
1969 28 p In FRENCH and DUTCH
Avail: NTIS

Tables of sulfur dioxide and smoke quantity (air pollution) measured at different weather stations in Belgium during November 1969 are presented. A brief description is given of the air sampling apparatus. ESRO

N70-42968# Weather Wing (4th), Ent AFB, Colo.
CLIMATIC ATLAS OF NORTH AMERICA MEAN SEA AND LAKE TEMPERATURES
Clarence E. Everson and Donald T. Brissett Jun. 1970 47 p *Its* Tech. Paper No. 70-3
(AD-709887) Avail: NTIS CSCL 4/2

Monthly charts of mean sea surface temperatures of the Atlantic Ocean from North America to 30 degrees W, Pacific Ocean from North America to 170 degrees E, and the mean lake surface temperature for the Great Lakes are presented. Author (TAB)

N70-43027# Texas A&M Univ., College Station. Dept. of Meteorology.
ANOMALOUS WINTERTIME PRECIPITATION IN THE WESTERN UNITED STATES AND RELATED METEOROLOGICAL VARIABLES
Lalovee G. Cobb Aug. 1970 176 p refs
(Contract DAAB07-68-C-0073; Proj. Themis)
(AD-710242; Rept-70-1-T; ECOM-0073-T-2; TR-2) Avail: NTIS CSCL 4/2

Significant anomalies of monthly precitation in the western United States are related to (1) anomalies of sea-surface temperatures in the eastern North Pacific Ocean, (2) anomalous flow associated with departures from normal sea-level pressure, and (3) differences in the flux of moisture. Examples are given showing that large-scale anomalies of temperatures of the ocean surface are coherent, making detection from month to month possible; these anomalies greatly influence the circulation of the overlying atmosphere and, in turn, are influenced greatly by the ever-changing atmospheric flow. The underlying ocean controls the development of large cyclones and anti-cyclones that persist for weeks, months, or even seasons by being a main source of moisture and energy. Anomalous geostrophic flow, related to departures from normal monthly sea-level pressure, are shown to be related closely to the distribution of anomalies of precipitation during the winter wet season. Anomalous flow off the land (or parallel to the coast) almost always is associated with a decrease in the amount of precipitation because the supply of moisture available for condensation is greatly diminished by such a trajectory. Author (TAB)

N70-43039 National Lending Library for Science and Technology, Boston Spa (England).
THE STRATOSPHERE WARMING IN FEBRUARY, 1966
Ju. P. Koshelkov et al 29 May 1970 13 p refs Transl. into ENGLISH from Tr. Cent. Aerol. Observ. (Moscow), no. 85, 1968 p 69-81
(NLL-M-9039-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The reversal of upper atmospheric circulation is analyzed, based on air contour charts and rocket soundings taken in the winter of 1966. Temperature and pressure conditions in the upper stratosphere are described for various regions including the Far East, Alaska, North Atlantic, Asia, Arctic, North America, and Europe. Air temperatures up to and during the warming period are covered as well as wind speeds, vertical distribution of temperature changes, zonal and meridional wind-speed components, and the anticyclone. Advection effects on the temperature-pressure field variations are also included. J.M.

N70-43117# Bureau of Meteorology, Melbourne (Australia).
AUSTRALIAN CLIMATOLOGICAL SUMMARY: UPPER AIR DATA, DECEMBER 1969
Dec. 1969 17 p refs
Avail: NTIS

Meteorological statistics for the upper atmosphere of Australia are given in tabular form. The statistics are derived daily from measurements of the wind, temperature and relative humidity. Included in the tables is information on geopotential, median mixing ratios, and vector winds. Radiosondes were used to make the measurements. E.H.W.

N70-43119 National Lending Library for Science and Technology, Boston Spa (England).
DIURNAL VARIATION OF RELATIVE HUMIDITY IN THE NORTH-WEST OF THE EUROPEAN USSR
I. A. Beresneva 29 May 1970 14 p refs Transl. into ENGLISH from Clav. Geof. Obs. Tr. Vyp. (Leningrad), v. 248, 1969 p 135 – 143
(NLL-M-9138-(5828.4F)) Avail: Natl. Lending Library, Boston Spa Engl.: 1 NLL photocopy coupon

Microclimatic features of irrigation, trees, and swamp conditions were studied to determine their effects on variations in relative humidity. Humidity measurements were made using the hygrograph. Comparisons were made between hilly, lowlands, coastal and island, and water areas. Results show hilly terrain has less humidity than the surrounding lowlands, coastal and island areas have the lowest humidity, and water areas have the highest with readings taken up to 30% daily. When measuring daytime values, only the influence of bogs and water basins on humidity changes could be clearly established. E.H.W.

N70-43136# Sandia Labs., Albuquerque, N. Mex. Test Operations Control Div.
WIND DATA FOR THE ALBUQUERQUE AREA
Clifford A. Olson, Mary H. Hall, and Herbert J. Plagge, comps. May 1970 464 p
(SC-M-70-144) Avail: NTIS

Daily wind direction and speed data are presented for low-altitude levels in the Albuquerque area. Author (NSA)

N70-43166# Air Force Global Weather Central, Offutt AFB, Calif.
FINE MESH UPPER AIR ANALYSIS MODEL
Rex J. Fleming 15 Dec. 1969 22 p refs
(AD-710203; AFGWC-TM-69-2) Avail: NTIS CSCL 4/2

Details of AFGWC fine mesh upper air analysis program are presented along with equations used to derive the first guess fields. The analysis technique is a method of successive corrections to the first guess field. A variable scan radius is used which maximizes details over dense data regions and which minimizes unwanted irregularities over sparse data regions. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N70-41856* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ROLL ATTITUDE STAR SENSOR SYSTEM Patent
Gerald W. Meisenholder, inventor (to NASA) Issued 22 Nov. 1966 (Filed 17 Aug. 1964) 7 p Cl. 244-1 Sponsored by NASA
(NASA-Case-XNP-01307; US-Patent-3,286,953; US-Patent-Appl-SN-390250) Avail: US Patent Office CSCL 17G

The described star sensor is capable of examining different small sectors of a total field of view developing an electron beam consisting of portions whose positions are related to the positions of stars within the field of view. By selectively deflecting the beam in a first direction relative to a target, only those beam portions related to stars within a selected small sector are able to find the target. The amount of deflection can be varied as the vehicle changes its position in orbit to permit different small sectors to be examined. The roll angle of the vehicle is ascertained by determining the amount of deflection required in a second direction for the beam positions to be brought into coincidence with the target. R.B.

N70-41930*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CLOSED LOOP RANGING SYSTEM Patent
Robert C. Bunce, inventor (to NASA) Issued 21 Feb. 1967 (Filed 11 Feb. 1965) 11 p Cl. 343-12 Sponsored by NASA
(NASA-Case-XNP-01501; US-Patent-3,305,861; US-Patent-Appl-SN-432027) Avail: US Patent Office CSCL 17G

A closed loop radio signal communication ranging system to determine the distance between a moving airborne vehicle and a fixed ground station is described. A dual carrier RF ground-to-air communication system is employed in which one of the carriers is operated in a closed loop configuration. The instantaneous received frequency by either the ground station or the vehicle in space controls the frequency of the instantaneous transmitted signal. By maintaining two communication locations, the absolute phase-difference between the receiving and transmitting terminals at each location is constant, regardless of the absolute frequency of the ranging carrier at any time. A cycle is simultaneously transmitted for each cycle received at either location and the total phase around the closed loop is constant at all times. The second carrier is maintained in a standard open loop condition so that conventional Doppler measurements may be made to produce a time-velocity profile of the vehicle with respect to the ground station. The distance between the vehicle and the ground station is determined by comparing the time or phase delays between the closed loop transmitting and receiving systems. R.B.

N70-42019*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
STABILITY OF SAS-A DUAL SPIN SPACECRAFT WITH ENERGY DISSIPATION ON THE MOMENTUM WHEEL
Peter M. Bainum Sep. 1970 39 p refs Submitted for publication
(NASA-TM-X-65353; X-732-70-344) Avail: NTIS CSCL 17G

The attitude stability of the SAS-A satellite with damping in the momentum wheel as well as the despun portion is analyzed. Wheel energy dissipation is modeled by assuming the wheel can flex with two degrees of freedom relative to the hub. The nonlinear attitude equations are derived for small wheel flexural motion and are a ninth order nonautonomous set. If the main body damper mass and wheel transverse moment of inertia are assumed small when compared with main satellite masses and inertias, an averaging process can be used to determine the zeroth and first order secular perturbations on the behavior of the system nutation angle. From this a general analytic stability criterion is established. A numerical evaluation of this criterion using SAS-A parameters and measured wheel damping data indicates that stability about a zero degree nutation angle is insured by a factor of 128 under normal operating conditions. Author

N70-42096*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
A CONTROL LAW FOR DOUBLE-GIMBALED CONTROL MOMENT GYROS USED FOR SPACE VEHICLE ATTITUDE CONTROL
Hans F. Kennel 7 Aug. 1970 40 p refs
(NASA-TM-X-64536) Avail: NTIS CSCL 17G

Space vehicle attitude control, which utilizes control moment gyros (CMG's) to develop the necessary control torques, requires the generation of CMG gimbal rate commands in such a way that the resulting precessional torques on the space vehicle equal the desired control torques; i.e., no torque crosscoupling occurs. Consideration of the combined effect of a pair of double-gimbaled CMG's allows the generation of a no-crosscoupling CMG control presented, the only difference between the commanded and the actual control torque exerted on the space station is caused by the difference between the commanded and the actual gimbal rates. The control law is expanded from the application to one CMG pair to the application to three CMG's. Three CMG pairs can then be formed and the desired control torque can be split between them

according to their relative control capability. Skylab-A is used as an example for the utilization of the excessive degrees of freedom to better distribute the CMG angular momentum vectors with respect to each other or to their gimbal stops without an effect on the total CMG angular momentum, i.e., without resulting in a net torque on the space vehicle. The general development of the CMG control law assumes arbitrary CMG momentum magnitudes; but it is also shown that the expressions can be simplified if it is assumed that all CMG angular momentum magnitudes are equal. Author

N70-42103*# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF AN EVALUATION TECHNIQUE FOR INTERPLANETARY MISSION ASTRIONICS Interim Scientific Report
Ellis F. Hitt, Fred G. Rea, Ronald W. Scott, and J. N. Blutreich Feb. 1970 207 p refs
(Contract NAS12-550)
(NASA-CR-114229; ISR-3) Avail: NTIS CSCL 17G

Evaluation of astrionics for interplanetary flyby missions was accomplished using penalty functions developed in the early phases of the study. The penalty functions were extended to permit evaluation of the astrionics required for orbiter, lander, and multiple planet swingby missions. Use of the Deep Space Instrumentation Facility tracking network throughout the mission is discussed as well as use of planetary approach sensors for navigation during the approach phase of the mission. Tradeoffs between alternate attitude control mechanizations employing gas reaction jets, control moment gyroscopes, and reaction wheels are analyzed. The effects of activating and deactivating subsystems as a function of the mission schedule are analyzed. The communication requirements between the spacecraft and earth are related to the mission navigation schedule. Two specific multiple midcourse correction strategies were investigated and results reported for a Mars flyby mission. Author

N70-42346# Royal Aircraft Establishment, Farnborough (England).
A COMMENTARY UPON AIRCRAFT NAVIGATION SYSTEMS
J. G. Carr and F. S. Stringer Oct. 1969 27 p Presented at the Symp. on Electron. for Civil Aviation, London, Sep. 1969
(RAE-TR-69220) Copyright. Avail: NTIS

Current civil air transport navigation aids are surveyed and it is concluded that a hybrid system, combining two or more dissimilar aids or sensors is desirable. Some of the significant design features and performance characteristics peculiar to the radio sensors chosen for possible inclusion in the hybrid are discussed, and the importance of digital management computers and CRT displays in integrated navigation systems is stressed. The experimental programme in a Comet aircraft is described. Author (ESRO)

N70-42655# Congress. House. Committee on Government Operations.
PROBLEMS CONFRONTING FAA IN THE DEVELOPMENT OF AN AIR TRAFFIC CONTROL SYSTEM FOR THE 1970'S
Washington GPO 1970 188 p refs Hearing before Comm. on Govt. Operations, 91st Congr., 2d, Sess., 27 Jan. 1970
Avail: Subcomm. on Govt. Activities

The hearings on developing an air traffic control system for the 1970's are reported. Subjects discussed include: (1) general description of air traffic control requirement through 1980, (2) inadequate funding of National Airspace System, (3) technical problems confronting FAA, and (4) collision avoidance. F.O.S.

N70-42974# Coast Guard, Baltimore, Md. Field Testing and Development Center.
FOG DETECTORS FOR UNMANNED AIDS TO NAVIGATION
Lloyd R. Lomer 17 Jul. 1970 116 p refs
(AD-710086; USCG-512) Avail: NTIS CSCL 4/2

Performance of atmospheric backscatter measuring systems as typified by the Impulsphysik Videograph B and AGA RTM-1 fog detectors for use in automatic control of fog signals is studied. Laboratory and Field Test programs covering 100,000 hours of operation were conducted to determine the effectiveness of these devices compared with visual observations. Ten geographical sites were selected for the field tests. Data is presented for both Videograph B performance and occurrence of inhomogeneous atmospheric conditions at each of these locations. Direct comparison tests comparing the two detectors with a 950 foot baseline transmissometer were made. Analysis is made concerning advisability of using the fog detectors for immediate unmanned automatic operation at remote sites. Possible methods of improving operation of low powered backscatter fog detectors operating in certain inhomogeneous atmospheric conditions are discussed. Author (TAB)

N70-43017*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
PRELIMINARY ANALYSIS FOR LUNAR ROVING VEHICLE STUDY. GROUND DATA SYSTEMS AND OPERATIONS. VOLUME 1: ROVING VEHICLE GUIDANCE (REMOTE DRIVING STUDY)
30 Jun. 1970 166 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952668)
(NASA-CR-110872; C0077-Vol-1) Avail: NTIS CSCL 17G

Considerations applicable to aid remote driving by superimposing driving aids on the TV panorama are discussed. These aids are used by the remote driver at the remote controller position while the vehicle is in motion. The vehicle general design baseline is first established. Author

N70-43018*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
PRELIMINARY ANALYSIS FOR LUNAR ROVING VEHICLE STUDY. GROUND DATA SYSTEMS AND OPERATIONS. VOLUME 2: ROVING VEHICLE PAYLOAD (SCIENCE MODE TIME LINE ANALYSES)
30 Jun. 1970 60 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952668)
(NASA-CR-110873; C0077-Vol-2) Avail: NTIS CSCL 17G

Four detailed time line studies of portions of the stationary science mode are presented. These studies provide an additional link in the continuing iterative process of defining the LRV mission operations procedure, ground equipment, and administrative organization. Author

N70-43019*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
PRELIMINARY ANALYSIS FOR LUNAR ROVING VEHICLE STUDY. GROUND DATA SYSTEMS AND OPERATIONS. VOLUME 3: ROVING VEHICLE NAVIGATION (ELEVATION DETERMINATION ANALYSES)
30 Jun. 1970 69 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952668)
(NASA-CR-110875; C0077-Vol-3) Avail: NTIS CSCL 17G

Elevation determination and some early unfinished work on rover navigation are presented. Preliminary error curves of rover position as affected by landmark orientation with respect to LRV path are shown; also, a table representing a partial comparison of various navigation schemes is included. The elevation determination methods considered are (1) use of the basic LRV instruments, (2) addition of a ranging laser and precision inclinometer, (3) tracking an orbiter from the rover, and (4) miscellaneous techniques including a stable platform, one or more star trackers, a sun seeker, gyrocompassing, Foucault pendulum, and differential ranging. The intent of the volume is to provide sufficient information concerning a varity of navigation and elevation determination methods to permit filtering out of less attractive schemes. Author

N70-43108# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF POWERED GYROSTABILIZER WITH DRY FRICTION
A. M. Formalskii 5 Jun. 1970 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Tverdogo Tela (Moscow), no. 4, 1969 p 17–22
(AD-710259; FTD-HT-23-282-70) Avail: NTIS CSCL 17/7

An analysis is presented of a powered gyrostabilizer with consideration of the forces of dry friction in the mounts of the frame. The problem of the stability of such a stabilizer is analyzed. Certain properties of the transient process are clarified. The method of point mappings is used in the analysis. Author (TAB)

N70-43139# Naval Postgraduate School, Monterey, Calif.
A PROPOSED DIFFERENTIAL OMEGA SYSTEM
Gill Reves Goodman (M.S. Thesis) Dec. 1969 130 p refs
(AD-709936) Avail: NTIS CSCL 17/7

Omega is a long range electronic navigation system which utilizes phase difference measurements between signals received from two transmitting stations to determine a line of position. The major cause of inaccuracy in the system is the propagation anomalies of the Omega signals. Differential Omega is based on the theory that throughout a small geographical region the phase difference errors caused by these anomalies are identical. A monitor site might be established within this area which would determine the extent of the error and relay this information to other users. It is the purpose of this thesis to present and test a workable Differential Omega system which utilizes a Coast Guard radiobeacon as a monitor site and the modulated radiobeacon signal to transmit the correction information. Author (TAB)

N70-43146*# National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
INVESTIGATION OF A DIGITAL AUTOMATIC AIRCRAFT LANDING SYSTEM IN TURBULENCE
Frank Neuman and John D. Foster Washington Oct. 1970 59 p refs
(NASA-TN-D-6066; A-3504) Avail: NTIS CSCL 17G

A digital system has been studied for automatically controlling the longitudinal motion of a large transport aircraft during the landing phase. The study was carried out by means of an all-digital simulation that was chiefly concerned with investigating the effects of gusts and wind shears on aircraft control near the ground. The performance of the automatic control system operating in turbulence was determined by a Monte Carlo technique. With respect to the digital control system, it was found that (1) the basic analog flare mode could be modified to improve its performance under conditions of turbulence and wind shear; (2) for most control modes the computation rate requirement is surprisingly low as indicated by the effects of computer repetition rate on the aircraft performance; (3) the performance degradation that results when a control computation cycle is ocassionally skipped is relatively minor, a fact that is significant when the computer is shared with other systems for which emergency computations may have to be performed. Author

N70-43185*# Sperry Rand Corp., St. Paul, Minn. Univac Federal Systems Div.
STRAPDOWN CALIBRATION AND ALIGNMENT STUDY. VOLUME 1: DEVELOPMENT DOCUMENT
D. M. Garmer, E. J. Farrell, S. Kau, and F. N. Bailey [1970] 232 p refs
(Contract NAS12-577)
(NASA-CR-110938) Avail: NTIS CSCL 17G

Techniques for laboratory calibration and alignment of a strapdown inertial sensing unit (ISU) were developed. Calibration is accomplished by measuring specific input environments and using the relationship of known kinematic input to sensor outputs to determine the constants of the sensor models. Inputs are the earth angular rate, the normal reaction force of gravity, and the angular rotation imposed by a test fixture in some cases. Alignment is made by three methods: (1) mirror alignment employs autocollimators to measure the earth orientation of the normals to two mirrors mounted on the ISU. (2) level alignment uses an autocollimator to measure the azimuth of the normal to one ISU mirror and accelerometer measurements and to determine the orientation of local vertical with respect to the body axes; and (3) gyrocompass alignment determines earth alignment of the ISU by gyro and accelerometer measurement of the earth rate and gravity normal force vestors. The development is presented as a rigorous systems engineering task and a step by step development of specific solutions is presented. Author

N70-43186# Sperry Rand Corp., St. Paul, Minn. Univac Federal Systems Div.
STRAPDOWN CALIBRATION AND ALIGNMENT STUDY. VOLUME 2: PROCEDURAL AND PARAMETRIC TRADE-OFF ANALYSES DOCUMENT
D. M. Garmer, E. J. Farrell, and D. E. Jones [1970] 118 p refs
(Contract NAS12-577)
(NASA-CR-110936) Avail: NTIS CSCL 17G

This volume contains the detailed trade-off studies supporting the developments given in Volume 1. Author

N70-43187*# Sperry Rand Corp., St. Paul, Minn. Univac Federal Systems Div.
STRAPDOWN CALIBRATION AND ALIGNMENT STUDY. VOLUME 3: LABORATORY PROCEDURES MANUAL
L. C. Smith, Jr. and D. M. Garmer [1970] 197 p refs
(Contract NAS12-577)
(NASA-CR-110973) Avail: NTIS CSCL 17G

The implementation of the selected procedures is presented. The laboratory procedures are presented by use of both detailed step-by-step check sheets and schematic representations of the laboratory depicting the entire process at each major step in the procedure. The equations to be programmed in the implementation of the procedures are given. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N70-41802# Atomic Energy Commission Research Establishment, Riso (Denmark).
ESTIMATE OF DOSES AT THE CERN PROTON SYNCHROTRON
E. Bjergbakke and C. Carlsson Apr. 1970 15 p refs
(RISO-M-1241) Avail: NTIS

Preliminary radiation dose data for low-Z materials in the immediate environment of the CERN proton synchrotron are presented. Dose data for scattered radiation from a copper target bombarded by 24 GeV protons and beryllium target bombarded by 12 GeV protons are included. The various dosimeters used are briefly discussed. NSA

N70-41815# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS ON DEVELOPMENT OF MATERIALS AND TECHNOLOGY FOR ADVANCED REACTORS Tasks 6, 7, 14, 32 Quarterly Report, Jan.–Mar. 1970
Donald L. Keller Apr. 1970 79 p refs

(Contract W-7405-ENG-92)
(BMI-1882) Avail: NTIS

Research and development results are presented on mechanical property design data for reactor materials; cladding, structural, and component materials; uranium-plutonium nitride fuels for LMFBR applications; and creep of reactor fuel materials. NSA

N70-41816# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY Quarterly Progress Report, Jan. – Mar. 1970
W. F. Seely, ed. Apr. 1970 316 p refs
(Contract AT(45-1)-1830)
(BNWL-1349-1) Avail: NTIS

Research progress is reported on nondestructive testing methods, ATR water loop operation and maintenance, irradiation damage to reactor materials, fast reactor dosimetry and damage analysis, development of ceramic fuels, irradiation behavior of fast reactor fuel materials, fast reactor absorber materials, and nuclear graphite. NSA

N70-41828# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ION MOTION IN THE CENTER OF THE JINR 2 METER ISOCHRONOUS CYCLOTRON
I. A. Shelaev, S. I. Kozlov, and V. M. Nikolaev 1970 16 p refs In RUSSIAN
(JINR-P9-5032) Avail: AEC Depository Libraries

The results of computer calculations of the initial motion of heavy ions in the 2-meter isochronous cyclotron using experimentally obtained distributions of electrical and magnetic fields are presented. Optimum position of the ion source, providing a minimum amplitude of radial oscillations and an axial ion focusing, is determined. Author (NSA)

N70-41830# Oak Ridge National Lab., Tenn.
THORIUM FUEL CYCLE DEVELOPMENT Progress Report, Apr. 1970
Jun. 1970 34 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3015; PR-9) Avail: NTIS

Progress is reported on head-end reprocessing development, refabrication development, materials irradiation, LWBR support program, and U-233 reprocessing. NSA

N70-41832# Oak Ridge National Lab., Tenn.
EXPERIMENTAL DYNAMIC ANALYSIS OF THE MSRE WITH U 233 FUEL
R. C. Steffy, Jr. Apr. 1970 28 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2997) Avail: NTIS

Tests were performed on the Molten-Salt Reactor Experiment to determine the system time response to step changes in reactivity, the neutron-flux-to-reactivity frequency response, and the outlet-temperature-to-power frequency response. The results of each of these were found to agree favorably with theoretical predictions. The time response tests were performed with the reactor operating at 1, 5, and 8 MW and substantiated the theoretical predictions that following a reactivity perturbation the system would return to its original power level more rapidly at higher power levels than at lower power levels and was load-following at all significant power levels. A noisy flux signal (caused by circulating voids) hampered detailed comparison of the experimental results and theoretical predictions. Neutron flux-to-reactivity frequency-response measurements were performed using periodic, pseudorandom binary, and ternary sequences. Author (NSA)

N70-41834# Arizona Univ., Tucson. Dept. of Nuclear Engineering.
ANALYTICAL AND EXPERIMENTAL STUDIES RELATING TO THE SIMULATED START-UP OF IN-CORE THERMIONIC REACTOR SYSTEMS
James Garfield Guppy (Ph.D. Thesis) Jun. 1970 192 p refs
(Contract AT(04-3)-670)
(TID-25443) Avail: NTIS

An analytical representation of a nuclear reactor containing incore thermionic devices suitable for transient studies is formulated. The resulting model is applicable to situations involving substantial changes in system operating conditions, as would be experienced during startup transients. Nuetron kinetics and heat transfer are represented by nodal descriptions. Contributions from all system regions of importance are retained to produce realistic transient response. The resulting set of equations is coupled to a digital computer integration routine to solve for the dynamic response. The thermionic converter physics is described by a complex iterative numerical scheme based on a diffusion approximation to the plasma processes. Other thermionic processes included are surface and Schottky effects, plus an accounting of the electrostatic sheaths present. The analysis is extended to include general application to thermionic diodes undergoing transients. The digital description of the reactor model is tested against a comparable analog computer simulation and shown to yield better accuracy. Author (NSA)

N70-41835# Bettis Atomic Power Lab., Pittsburgh, Pa.
CYGRO-3: A COMPUTER PROGRAM TO DETERMINE TEMPERATURES, STRESSES AND DEFORMATIONS IN OXIDE FUEL RODS (LWBR DEVELOPMENT PROGRAM)
E. Duncombe, C. M. Friedrich, and J. K. Fischer Mar. 1970 86 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-961) Avail: NTIS

The CYGRO-3 computer program is an updated version of CYGRO-2. Time-dependent stresses and deformations are calculated for oxide fuel rods as a result of a history of power, coolant pressure and temperature etc., assuming axial and circumferential uniformity. Major changes are the incorporation of void migration, fuel cracking, fuel-clad interaction if the clad is collapsed, effect of loads at the rod supports, effect of neutron flux on creep, clad anisotropy, first order calculation of bending moments and deflections caused by nonuniform power distribution across fuel rod, and dynamic relations for hardening and recovery. Provisions are also made for use of the Bettis input data package for easy specification of input, together with options regarding repetition of history data for cyclic operation, and optional suppression of some output data. This computer program was developed as part of the LWBR development program. Author (NSA)

N70-41854# Atomic Energy Commission Research Establishment, Riso (Denmark). Research Establishment.
RADIOCHEMICAL PROCEDURES FOR THE DETERMINATION OF PLUTONIUM IN ENVIRONMENTAL SAMPLES
Erik Kjaer Markussen Apr. 1970 5 p refs
(RISO-M-1212) Avail: NTIS

The environmental samples collected during the radioecological studies after the B-52 accident at Thule were analysed for plutonium according to the procedures given. The solid samples were ashed at 600 C, and after the addition of carriers and spikes the ash was melted with potassium pyrosulphate to ensure that all plutonium was in a soluble form before the radiochemical analysis, which was developed especially for this purpose by a combination of an American ion-exchange procedure and a Danish solvent extraction method. After the radiochemical analysis, which could be accomplished within a day for most types of samples, the samples were counted on silicon surface barrier alpha counters in connection with a multichannel analyser. Author (NSA)

N70-41857# Oak Ridge National Lab., Tenn.
REACTOR POWER MEASUREMENT AND HEAT TRANSFER PERFORMANCE IN THE MOLTEN SALT REACTOR EXPERIMENT
C. H. Gabbard May 1970 32 p refs
(ORNL-TM-3002) Avail: NTIS

The operating power of the MSRE was routinely determined by a heat balance on the fuel and coolant salt systems performed by the on-line computer. This gave a calculated full power level of 8.0 MW. However, changes in the isotopic composition of uranium and plutonium in the fuel salt indicated a power lower than the 8 MW by about 7 to 10%. Attempts to resolve this discrepancy included a measurement of the coolant salt flow rate by the radioactive decay of activation products in the coolant salt, a recalculation of the coolant system pressure drop, and a heat balance on the air side of the coolant radiator. In the case of the primary heat exchanger, the over-estimate was due to the use of erroneous, estimated physical property data. In the case of the radiator, the overestimate in the design was only partially explained by the improper selection of an air film temperature. There was no decrease in heat transfer capability of the two heat exchangers over more than 3 years of operation. NSA

N70-41858# Argonne National Lab., Ill.
BOW-V A CDC-3600 PROGRAM TO CALCULATE THE EQUILIBRIUM CONFIGURATIONS OF A THERMALLY BOWED REACTOR CORE, EBR 2 PROJECT
D. A. Kucera and D. Mohr Jan. 1970 125 p refs
(Contract W-31-109-eng-38)
(ANL/EBR-14) Avail: NTIS

The BOW-5 program calculates the equilibrium configurations of closely spaced, parallel beams (simulating the subassemblies) which are thermally distorted. The beams can contact and thus mechanically interact with each other at their tops and at an intermediate level. Interference between the beams and a fixed grid below the pivot is also possible. The axial distribution of radial temperature gradients across the beams is arbitrary. The BOW-5 model provides for the influence of bowing in one row of subassemblies on any other row in the reactor. All possible modes of bending are included, and each beam can have different moments of inertia above and below the pivot. The contact points have arbitrary compressibility. The model provides for thermal expansion of the lateral dimensions of the subassembly hex can at the intermediate contact point. The program determines the positions of free pivoting beams as well as the deflections of fully loaded beams. Equation derivations, input/output specifications, and FORTRAN listing are presented. A sample problem is included. Author (NSA)

N70-41860# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton.
NIMROD OPERATION AND DEVELOPMENT Quarterly Report, 1 Jul. – 30 Sep. 1969
D. E. Gray, ed. Feb. 1970 26 p refs
(RHEL/R-194) Avail: HMSO 5s 6d; BIS $1.10

The Nimrod beam was on for high energy physics research for 87.2% of H.E.P. scheduled operating time. One experiment was completed, two commenced, and twelve continued through in this quarter. A review of extracted proton beams on Nimrod is given. The third extracted proton beam X3 has been commissioned successfully. Author (NSA)

N70-41861# Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik.
DEVELOPMENT OF A VARIABLE CONDUCTOR WITH A CHARACTERISTIC IMPEDANCE Z SUB O = 100 OHMS [ENTWICKLUNG EINER MEANDERLEITUNG MIT EINEM WELLENWIDERSTAND Z SUB O = 100 OHMS]
P. M. Fischer and L. Husson Mar. 1969 30 p refs In GERMAN
(KFK-1010) Avail: AEC Depository Libraries

To deflect a cyclotron beam, a meander system of conductors with a wave resistance of Z sub o = 100 ohms was developed. It consisted of a plate covered with strip conductors. Arrangement of the conductors was determined by mathematical and experimental approximation procedures and, also, by direct mathematical analysis based on the predetermined wave resistance of Z sub o. Author (NSA)

N70-41868# United Kingdom Atomic Energy Authority, Warrington (England). Reactor Group.
GAS-COOLED REACTORS, PERFORMING AND PROSPECTIVE
G. R. Bainbridge May 1970 30 p refs Submitted for publication
(TRG-Report-1924) Avail: AEC Depository Library

The experience in design, construction and operation of gas-cooled reactor power stations is reviewed. Reference is made to the gas -cooled reactor power stations already operating and under construction in Britain, France, Italy and Japan. Possible developments from these designs supported by the experimental work on high temperature reactors in the O.E.C.D. Dragon Project, U.K., Peach Bottom, U.S.A., and Julich, Germany, are discussed. Author (NSA)

N70-41898# Idaho Nuclear Corp., Idaho Falls.
EXPERIMENTAL STUDIES OF THE EFFECT OF FLOW RESTRICTIONS IN A SMALL ROD BUNDLE UNDER EMERGENCY CORE COOLANT INJECTION CONDITIONS
P. R. Davis [1970] 22 p refs Presented at the Spec. Symp. on Fuel Rod Failure and its Effects in Conjunction with the 16th Ann. Am. Nucl. Soc. Meeting, Los Angeles, 28 Jun. – 2 Jul. 1970
(Conf-700608-11) Avail: NTIS

The effect of partial and total subchannel flow blockage on the capability of the emergency core coolant to remove heat from those portions of the fuel above the blocked area is studied. Test facilities are described. Test results are presented. NSA

N70-41902*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRECRITICAL ANALYSIS OF A POWER-TAILORED FAST-SPECTRUM MOLYBDENUM REFLECTED CRITICAL ASSEMBLY
Wendell Mayo Sep. 1970 16 p refs
(NASA-TM-X-52895) Avail: NTIS CSCL 18I

A series of critical experiments to estimate the fuel loading requirements for a power-tailored fast-spectrum reactor is discussed. The materials used are lithium 7, nitrogen, uranium 235 and 238, and the refractory metals molybedenum, hafnium, tantalum, and tungsten. The conceptual reactor, the critical machine, the fuel element design, neutronic calculation procedures, and results of precritical calculations are illustrated. Power distribution calculations are also presented for the proposed fuel loading schedule. R.B.

N70-41924# Osaka Univ. (Japan). Lab. of Nuclear Studies.
[LABORATORY OF NUCLEAR STUDIES] Annual Report, Jan. 1969 – Dec. 1969
Dec. 1969 25 p refs
(OU-LNS-70-1) Avail: AEC Depository Libraries

This report is a review of the research and technical development conducted at the Laboratory of Nuclear Studies, Osaka University during the year ending December 1969. The work was performed primarily by faculty and graduate students of the Department of Physics, Chemistry and Biology and by the staff of the Laboratory. The principal facilities of the Laboratory are a 110 cm cyclotron, 1 4-MeV Van de Graaff accelerator, a 400-keV Crockcroft–Walton accelerator, and several types of mass-spectrometers. The design study for the construction of a 230 cm isochronous cyclotron and accessory equipment was continued

this year. The Ministry of Education agreed to start the construction in the fiscal year 1970. The site of the new cyclotron will be Suita Campus of Osaka University (about 4 km apart from Toyonaka Campus), and the facility will be operated by cooperative works of the nuclear research groups in the whole country. Author (NSA)

N70-41925# Institutt for Atomenergi, Halden (Norway).
APPLICATION OF A NON-INTERACTING CONTROL SCHEME IN THE DIRECT DIGITAL CONTROL OF THE HBWR
H. Roggenbauer, K. Homslo, and F. Griess Feb. 1970 49 p refs
(HPR-122) Avail: NTIS

The conceptual development and experimental demonstration of so-called non-interacting control are described. Several process variables of the HBWR plant normally controlled by conventional analogue PID-controllers, have intermittently been controlled in direct digital (PID) control mode. However, in this mode of control where several variables are controlled independently, the different process variables influence each other due to the inherent dynamics of the process. Because of these process interactions, which can in particular be observed when setpoint changes are introduced, it was assumed that improved control could be obtained through decoupling the interacting loops. Three loops of the plant which are believed to have the strongest inherent couplings were selected for the demonstration of a control system which minimizes interactions between control loops. Author (NSA)

N70-41937# Societe Belge pour l'Industrie Nucleaire, Brussels (Belgium).
THERMAL BEHAVIOR OF URANIUM AND PLUTONIUM OXIDE CERAMIC FUELS UNDER HIGH SPECIFIC RATING IRRADIATION
A. Lhost and B. van Outryve d'Ydewalle Nov. 1969 37 p refs
(Contract EURATOM-001-64-1-TRUB)
(EURAEC-2137) Avail: NTIS

A particular variant of the technique for the vibration of dense uranium and plutonium oxide powders was developed, which consisted in introducing the latter substance only into the fine fraction of the powders. The radiation program set up to test the behavior of the produced fuels was divided into two phases: a development phase including irradiation in test reactors, and a demonstration phase made up of irradiation in power reactors. The overall results obtained by the irradiation of fifteen fuel rods with stainless steel cladding are presented. The capacity values achieved in all the rods with stainless steel cladding irradiated within the framework of this program are given. These values were obtained from the overall radio-chemical measurements achieved in different sections of the rods and the undisturbed neutron flux readings carried out during the different irradiation runs. Author (NSA)

N70-41938# National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.
NIMROD OPERATION AND DEVELOPMENT Quarterly Report, 1 Oct. – 31 Dec. 1969
D. E. Gray, ed. Mar. 1970 16 p ref
(RHEL/R-195) Avail: NTIS

The Nimrod beam was on for high energy physics research for 87.7% of H.E.P. scheduled operating time. Three experiments were completed, ten continued through, and one commenced in this quarter. Author (NSA)

N70-41951# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
SAXTON PLUTONIUM PROJECT Quarterly Progress Report, Period Ending 31 Mar. 1970
W. R. Smalley May 1970 35 p refs
(Contract AT(30-1)-3385)
(WCAP-3385-23) Avail: NTIS

The research and development concerning the utilization of plutonium enriched fuel in pressurized water reactor systems is reported. The work discussed includes: metallographic examination of fuel rods, and hydrided cladding; and burnup analysis of radial drill samples. F.O.S.

N70-41970# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NUCLEAR SAFETY Quarterly Report, Feb. – Apr. 1970
May 1970 117 p refs
(Contract AT(45-1)-1830)
(BNWL-1315-2) Avail: NTIS

Acoustic emission testing was developed for pipe failure detection. Radiation effects on fracture heavy steel plates are discussed, along with radioactive waste fixation. Containment systems experiment for removing fission products from the air is described. An engineered safeguards systems analysis of environmental consequences of reactor accidents and a computer code for potential radiological hazards are also reviewed. J.A.M.

N70-41990# Gulf General Atomic, San Diego, Calif.
MW(E) PROTOTYPE HIGH TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM Quarterly Progress Report, Period Ending 30 Apr. 1970
28 May 1970 51 p refs
(Contract AT(04-3)-314)
(GA-10099) Avail: NTIS

Tasks discussed are: core 2 fuel loading and physics testing, reactor materials behavior, and helium purification system effectiveness. Operational highlights include: (1) the Peach Bottom reactor remained shut down; (2) the remaining 78 failed fuel elements were removed and core 2 loading was begun; (3) Po-Be neutron sources were placed in the reactor during loading and the reactor reached criticality with 192 core 2 elements loaded; (4) particulate matter samples in the main loop dust collectors were packaged and shipped; and (5) two reflector elements were cut at the Peach Bottom site and the bottom 15 inches (which contain Charpy steel vessel irradiation surveillance specimens) were shipped for further study of the NDTT shift. E.C.

N70-42040*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF D2O ON INCREASING THE NEUTRON FLUX NEAR A FUELED CAPSULE IN THE PLUM BROOK MOCK-UP REACTOR
Klaus H. Gumto [1970] 31 p refs
(NASA-TM-X-52894) Avail: NTIS CSCL 18J

The effects of surrounding a fueled capsule mock-up with a tank filled with D2O were tested. Replacing the H2O with D2O increased the thermal neutron flux by a factor of 2.4 at the fuel region, and a factor of 11 on the side of the test hole facing away from the core. The effects of the capsule wall and the fuel, as well as the gamma heating were also investigated. Author

N70-42061# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
EBR-2 DOSIMETRY TEST DATA ANALYSIS (REACTOR RUNS 31E AND 31F)
W. N. McElroy, J. L. Jackson, J. A. Ulseth, and R. L. Simons Jun. 1970 96 p refs
(Contract AT(45-1)-1830)
(BNWL-1402) Avail: NTIS

Data from the dosimetry test yield the result of 2.1 × 10 to the 15th power n/sq cm-sec for the total flux level at EBR-2 Row 2 – midplane as measured in a dosimetry structural

subassembly and at a stated reactor power of 50 MW. The value of 2.1 × 10 to the 15th power n/sq cm-sec agrees to within approximately 10 to 15% with values based on reactor physics and power considerations and fuel burnup measurements. Previously reported larger differences are attributed mainly to use of incorrect cross sections data and in the stated value of low power for Run 25a. Results from a number of fast reactor tests require a reduction in previously reported EBR-2 core spectral averaged cross section values of 25% for the Fe-54(n,p) and 30% for Ni-58(n,p) reaction to achieve consistency with results from fission reactions. Measured reaction rates were used to generate flux-spectra solutions for different radial and axial locations. For Row 2—axially, flux-spectral differences were observed between low and high power and between the edge and center of a structural subassembly. It is concluded that fission and nonfission flux monitors are necessary in experimental subassemblies to secure accurate flux and fluence data for materials irradiation tests in EBR-2. Author (NSA)

N70-42064# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY Quarterly Progress Report, Oct.—Dec. 1969
Jan. 1970 46 p refs
(Contract AT(04-3)-189)
(GEAP-10143; QPR-19) Avail: NTIS

Reliability investigations on reactor system piping are reviewed. Progress in probability analysis, stress analysis, fracture mechanics, low cycle fatigue ,mechanics, and BWR environmental effects analysis are discussed. E.C.

N70-42072# Idaho Nuclear Corp., Idaho Falls.
FISSION PRODUCT BEHAVIOR ANALYTICAL DEVELOPMENT PROGRAM Technical Description
Jun. 1970 28 p refs
(Contract AT(10-1)-1230)
(IN-1380) Avail: NTIS

Analytical models for predicting the behavior of fission products in a loss-of-coolant accident for a water-moderated nuclear power reactor are described. Model development is proposed for specific steps in the transport of fission products from the fuel to the reactor containment building. These areas of fission product behavior are: release from the fuel to the fuel-cladding gap, venting of the fuel-cladding gap upon cladding rupture, transport through the reactor vessel, and behavior within the containment building. A summary of related analytical programs on fission product behavior and a summary of the models existing for each of the steps for which development is planned are included. Author (NSA)

N70-42164*# AiResearch Mfg. Co., Phoenix, Ariz.
CONTROL SYSTEM FOR THE 2- TO 15-k We BRAYTON POWER SYSTEM Final Report
30 Aug. 1970 144 p refs
(Contract NAS3-10943)
(NASA-CR-72697; APS-5284-R24) Avail: NTIS CSCL 18N

The requirements for the Brayton engine control system, designed to provide control and protection for a Brayton power system, are discussed. The basic objectives were to develop control techniques and circuitry that would provide flexibility during initial power system testing, yet meet the basic requirement of reliability and fail-safe operation associated with a 5-yr space mission. The control system consists of an engine mounted signal conditioner connected to an operator control panel through a hard wired cable system. A detailed discussion of the control system, including design and salient features, is presented. Author

N70-42181*# Parametrics, Inc., Waltham, Mass.
ULTRASONIC MEASUREMENT OF CORE MATERIAL TEMPERATURE Final Report
L. C. Lynnworth and D. R. Patch Mar. 1970 56 p refs
(Contract NAS3-10284)
(NASA-CR-72717) Avail: NTIS CSCL 18J

Sheaths designed to protect a thin wire ultrasonic thermometer from 5300 R graphite/hydrogen environment expected in nuclear rocket engines were laboratory tested. Eight Ta-sheathed lines were installed in mock fuel elements and cycled in a graphite/helium environment up to 5400 R. The sheaths survived. Attenuation was overcome, permitting signals to be observed clearly, and measured automatically. The measured transit times exhibited drift, which is not yet explained. Author

N70-42201*# General Electric Co., Schenectady, N.Y.
CHARACTERISTICS OF A THERMIONIC CONVERTER WITH A CHLORIDE VAPOR DEPOSITED TUNGSTEN EMITTER (110) AND A COLLECTOR OF MOLYBDENUM DEPOSITED ON NIOBIUM
V. C. Wilson and S. P. Podkulski Washington NASA Oct. 1970 48 p refs
(Contract NAS3-8511)
(NASA-CR-1699; GESP-9011) Avail: NTIS CSCL 10B

A parallel plane, variable spaced laboratory thermionic converter consisting of a chloride vapor deposited tungsten emitter of (110) crystal orientation and a collector of molybdenum surface layer deposited on a niobium base was built and tested. Current-voltage characteristics were obtained for a range of emitter temperatures from 1650 to 2035 K, collector temperatures from 993 to 1023 K, cesium reservoir temperatures from 573 to 653 K, and interelectrode spacings from 5 to 20 mils. Post test analyses show the collector surface to be molybdenum and niobium. The collector thermionic characteristics are primarily those of niobium. Author

N70-42204# Naval Research Lab., Washington, D.C.
THE INFLUENCE OF COMPOSITION ON THE FRACTURE TOUGHNESS OF COMMERCIAL NUCLEAR VESSEL WELDS Interim Report
Landell E. Steele 23 Jun. 1970 21 p refs
(Contract AT(49-5)-2110)
(AD-709554; NRL-7095) Avail: NTIS CSCL 18/10

Irradiation studies of welds of the ASTM Type A302-B and A533-B steels, most commonly used for commercial water reactor vessels, demonstrated several instances in which the weld metal exhibited lower fracture toughness or greater elevation of the brittle-to-ductile transition temperature than that observed for the companion base-plate and weld heat-affected-zone material. Examination of the structure and composition led to the conclusion that composition is critical to the level of radiation-induced embrittlement. The level of copper and phosphorus contents has been shown to be especially critical to the level of embrittlement with welds having high copper (0.20%) and phosphorus (0.015%) showing greater embrittlement than those containing lesser amounts. These experimental observations were verified through laboratory tests in which these constituents and other residual elements were controlled in weldments simulating those for reactor service. Author (TAB

N70-42205# Idaho Nuclear Corp., Idaho Falls.
NUCLEAR SAFETY PROGRAM DIVISION Quarterly Technical Report, 1 Jul.—30 Sep. 1970
K. A. Dietz, ed. May 1970 117 p refs
(Contract AT(10-1)-1230)
(IN-1319) Avail: NTIS

Nuclear safety operations are summarized under the following headings: (1) thermal hydraulic analysis and critical flow condition during a loss-of-coolant accident; (2) heat transfer analysis and an examination of rod bundle critical heat flux data with application to loss-of-coolant accident analyses; (3) comparison of RELAP3 results with containment systems experimental blowdown results; (4) Carolinas Virginia Tube Reactor in-plant tests; and (5) SPERT 4 subassembly test program. E.C.

N70-42287# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.

ACOUSTIC EMISSION FROM STEEL PRESSURE VESSELS

A. Nielsen, F. G. Latham, and N. Kirby Apr. 1970 13 p refs

(TRG-Report-1983) Avail: AEC Depository Libraries

Preliminary investigations were made of acoustic emission from mild steel pressure vessels. Using piezoelectric accelerometers of 60 kHz and 120 kHz natural frequency the acoustic activity was found to be high in the initial stages of pressurization and to decrease at higher pressures. A similar pattern was followed by vessels containing large defects although the rate of emission was greater. There was no significant increase in the rate of emission as the vessels approached failure. Repeated pressurization of vessels showed reduced acoustic activity on second and subsequent pressure cycles especially when the rest period between cycles was short. Further investigation is necessary to relate acoustic signals (in terms of amplitude, rate and frequency) with metallurgical changes (deformation, cracking, tearing etc.) in the structure. Author (NSA)

N70-42300# Institutt for Atomenergi, Halden (Norway).

HBWR Quarterly Progress Report, Oct.–Dec. 1969

Feb. 1970 100 p refs

(HPR-117) Avail: AEC Depository Libraries

The DDC experiment with modern control theory was completed with a steady state run. The reactor hall was inspected for heavy water leakage. The sequence control system for the purification circuit was installed, and the steam generator was chemically cleaned. The power distribution evaluation system composed of three parts is reviewed: (1) an off-line reference system, (2) a predictive on-line calculation system for relatively small changes in control rod configurations, and (3) a monitoring on-line system. Conceptual studies on adaptive control of single control loop are being performed in simulation experiments. Forty-three test assemblies were irradiated, and no fuel failure was observed. The performance of various types of flux detectors was studied and compared. Attempts to seal weld austenitic steel and Inconel ferrules to 1 mm OD Inconel clad cables by electron beam welding were successful. J.A.M.

N70-42304# United Kingdom Atomic Energy Authority, Culham (England). Culham Translations Office.

MAGNETIC FIELD STRUCTURE IN THE TOR-1 STELLARATOR WITH $1 = 2$

E. D. Andryukhina et al [1970] 16 p refs Transl. into ENGLISH from the Russian

(NP-TR-1860; CTO-662) Avail: AEC Depository Libraries

The results of magnetic measurements in TOR-1 are reported. The existence of closed surfaces is experimentally confirmed. The resonance region is investigaged. The maximum rotational transform is i approximately equal to 4 to 4.5, with a maximum shear theta approximately equal to 3 × .01. Author (NSA)

N70-42591# Joint Committee on Atomic Energy (U. S. Congress).

AEC AUTHORIZING LEGISLATION, FISCAL YEAR 1971. PART 1: GENERAL, SPACE NUCLEAR PROGRAM, AND RADIATION PRESERVATION OF FOODS

Washington GPO 1970 489 p refs Hearings before Joint Comm. on At. Energy, 91st Congr., 2d Sess., 8, 18, and 19 Feb. 1970

Avail: SOD $1.75

The hearings on the overall review of the proposed AEC budget for fiscal year 1971 are reported. The testimony includes discussions on: (1) environmental program, (2) policies on obtaining raw materials for nuclear fuels, (3) weapons program, (4) reactor development, (5) physical research, (6) atomic bomb casualty studies, (7) nuclear reactor program, (8) NERVA development program, and (9) radiation preservation of foods. Cost estimates are also included. F.O.S.

N70-42733* # Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

CASCADED THERMOELECTRIC TEST GENERATOR Final Report

25 Sep. 1970 102 p Prepared for JPL

(Contracts NAS7-100; JPL-952196)

(NASA-CR-110877; WANL-PR-(DDD)-006) Avail: NTIS CSCL 20C

A two-stage cascaded thermoelectric test generator was designed and fabricated. The design is based on state-of-the-art thermoelectric technology and represents an integration of three proven engineering devices into a compact space power supply test system. The generator consists of a high temperature silicon germanium stage which is thermally coupled to a lead telluride tubular module stage by a sodium heat pipe. A high temperature tantalum electrical heater was designed to thermally simulate a radioisotope heat source. The generator, heat source, and a calorimetric heat sink, were assembled within a vacuum chamber. The design efficiency goal for the cascaded unit is a minimum of seven percent. It is anticipated that the test assembly will demonstrate an overall efficiency of at least 8.8 percent and generate 213 watts of electrical power at reference operating conditions. Author

N70-42735 National Lending Library for Science and Technology, Boston Spa (England).

DEVELOPMENT OF NEUTRON RADIOGRAPHY WITHIN THE CEA

J. L. Boutaine 8 Jun. 1970 17 p refs Transl. into ENGLISH from Bull. Inform. Sci. Tech. (Paris), no. 136, 1969 p 35–44

(NLL-LB/9/2811-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Swimming pool reactors and neutron radiographic devices, using the principle of the immersed conical collimator, provide satisfactory means of examining the various systems designed for studying the different fuels and structural materials used in nuclear technology. After briefly recalling the advantages and disadvantages of the neutron radiography method, the devices in service are described and some examples of their present day practical use in nuclear technology are given as well as some suggestions for their use outside the nuclear field. Finally, the first results of research on the possibilities of using neutron generators and radioisotopic sources are described. Author

N70-42750# Los Alamos Scientific Lab., N.Mex.

DETERMINATION OF OXYGEN IN REFRACTORY OXIDES: GAS CHROMATOGRAPHIC METHOD

D. E. Vance, M. E. Smith, and G. R. Waterbury Apr. 1970 7 p refs

(Contract W-7405-eng-36)

(LA-4439) Avail: NTIS

The oxygen content of refractory oxides is obtained by measuring with a gas chromatograph the carbon monoxide and carbon dioxide formed when the oxide is reacted with carbon at 2000 C in a stream of helium. The carbon monoxide and carbon dioxide evolved are adsorbed on a silica gel trap immersed in liquid nitrogen. These gases are desorbed by heating; flushed, along with a measured volume of neon to serve as an internal standard, into a 2-liter reservoir by a stream of helium; and mechanically mixed. A measured volume of the mixed gases is injected into the gas chromatograph by means of a sampling valve, and the quantities of carbon monoxide and carbon dioxide are obtained by electronic integration of the areas under the resultant chromatographic peaks. From these values, the quantity of oxygen in the refractory oxide is calculated. The relative standard deviations for a single determination are 0.6 and 0.8% in determining oxygen in uranium oxide and (uranium, plutonium) dioxide, respectively. Author (NSA)

N70-42781 National Lending Library for Science and Technology, Boston Spa (England).
CALIBRATION OF THE CONTROL RODS OF A REACTOR BY THE XENON METHOD
A. Buono et al [1970] 10 p Transl. into ENGLISH from Ing. Nucl. (Milan), v. 9, no. 5, 1968 p 17 – 22
(NLL-RISLEY-Trans-1840-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The calibration curves for the control rods in gas-graphite reactors are derived by measuring the xenon transient. The representative xenon concentration transients of each of the zones in which the reactor core is conceptually subdivided are determined. Synthesis of the transients is carried out on the basis of the local reactivity flux corresponding to the given concentrations. The theoretical transient is compared with experimental results. R.B.

N70-42784# Sandia Corp., Albuquerque, N.Mex.
AEROSPACE NUCLEAR SAFETY PROGRAM Quarterly Report, 1 Jan. – 31 Mar. 1970
A. J. Clark, Jr. Apr. 1970 51 p ref
(SC-PR-70-222) Avail: NTIS

Impact tests and postmortems of the Transit heat source were completed. A Task 8 heat source was exposed to simulated reentry conditions and the heat shield wall ablated through in the stagnation line area about 30 seconds after the point of peak heating rate. The temperature and velocity of a modified Pioneer heat source at eart impact were determined. Alpha particles were thermalized in a band approximately 9 micrometers from the surface of Mo foil. Helium bubbles precipitated in the region of the alpha band after the sample was aged and annealed. Scaling laws were developed for fueled capsules subjected to blast loading fragment impact, and earth impact. NSA

N70-42785# Oak Ridge National Lab., Tenn.
ISOTOPE KILOWATT PROGRAM Quarterly Progress Report, Period Ending 31 Mar. 1970
Jul. 1970 56 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3011) Avail: NTIS

A reference design study for an organic Rankine cycle system was directed toward the use of Dowtherm A at a temperature of about 600 F where thermal degradation should not be serious, even for periods of as much as five years. An organic Rankine cycle power plant configuration was incorporated in the reference design to give important advantages with respect to control of the liquid inventory while at the same time reducing the overall size of the power unit. A heat block-shield design with a cluster of 7 capsules was developed. Materials considerstions, particularly the 10 meter drop test, led to the choice of low carbon iron as the heat block-shield material. The use of a large number of layers of aluminum wire screen, was investigated and analyses indicated that it should satisfy both the thermal insulation and thermal fuse requirements. A new reference design for a complete power unit employing a set of thermoelectric modules and heat pipes was worked out. NSA

N70-42800# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
FABRICATION OF ORNL SERIES 1 IRRADIATION TEST CAPSULES FOR EXPERIMENTAL BREEDER REACTOR 2
W. L. Moore (GE Baltimore), M. K. Preston, and J. D. Sease Jul. 1970 76 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2922) Avail: NTIS

Five capsules were fabricated for irradiation tests in the Experimental Breeder Reactor 2. Each capsule contained one stainless steel fuel pin loaded by the Sphere-Pac process with 73 g of coarse and fine grades of (U sub 0.80, Pu sub 0.20)O sub 1.98 (enriched 93%) microspheres produced by the ORNL sol-gel process. Each fuel pin contained an extensometer for measuring the elongation of the fuel column. A sodium heat-transfer bond filled the annulus between the fuel pin and the capsule wall. The fuel pins and capsules were inspected by nondestructive techniques: helium leak check, radiography, gamma-attenuation scanning, and dye penetrant. Significant fabrication problems resolved included effecting the sodium bond, maintaining the sodium annulus, and tack welding the fuel pin to the capsule. Author (NSA)

N70-42809# California Univ., Livermore. Lawrence Radiation Lab.
SOME NEUTRONIC ASPECTS OF A DT FUSION REACTOR
J. D. Lee 28 May 1970 44 p refs Presented at the Symp. on Fusion Reactor Design, Lubbock, Tex.
(UCRL-72493; CONF-700614-1) Avail: NTIS

Fusion reactors based on the deuterium-tritium (DT) fusion reaction must produce tritium to be a viable power source. A survey of papers on the subject shows that attractive tritium production looks achievable. Some other neutronic considerations of DT fusion power are also discussed. Author (NSA)

N70-42815# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
LOW-CYCLE FATIGUE OF PROTOTYPE PIPING
E. Kiss, J. D. Heald, and D. A. Hale Jan. 1970 100 p refs
(Contract AT(04-3)-189)
(GEAP-10135) Avail: NTIS

Details of testing, data, and analysis of prototype piping and components subjected to low-cycle fatigue are presented. The specimens were fabricated from materials used for the primary piping of pressurized water and boiling water nuclear reactor systems. Data have been obtained for cycles to crack initiation, through-wall and circumferential crack growth at room temperature and 550 F. Comparisons are made of fatigue data obtained from the prototype piping and laboratory tests of flat plates and round bars of similar materials. In addition, predictions of fatigue life are made according to the procedures of the ASME Nuclear Power Piping Code (B31.7) and compared with prototype test results. Data are included which show that piping components at BWR operating pressure, subjected to continued low-cycle fatigue loading, are almost certain to leak rather than fracture suddenly Author (NSA)

N70-42818# Battelle-Northwest, Richland, Wash. Safety and Standards Div.
RADIOLOGICAL DESIGN CRITERIA
25 Mar. 1970 50 p refs
(BNWL-MA-3) Avail: NTIS

The Radiological Design Criteria Manual, prepared to assist management and design engineers in the planning abd design of buildings where radioactive materials or radiation generating machines are to be used, is presented. The criteria in this manual are intended to characterize the physical protective features which are required in the design or modification of such a building. These criteria, from a radiation protection point of view, relate to operability of the building within the rigorous protection standards applied to the work force. Author (NSA)

N70-42830# Oak Ridge National Lab., Tenn.
[SOLID STATE RESEARCH] Annual Progress Report, Period Ending 31 Dec. 1969
Feb. 1970 125 p refs
(Contract W-7405-eng-26)
(ORNL-4526) Avail: NTIS

Research is reported in the following section areas: radiation damage; dislocations and radiation effects on plastic deformation; surface studies, X-ray diffraction, and channeling; electronic and optical properties; electron spin resonance; magnetic properties; lattice dynamics; low temperature properties; research materials and experimental equipment and new techniques. NSA

N70-42841# Minnesota Mining and Mfg. Co., St. Paul, Minn. Electrical Products Group.
SNAP-23A PROGRAM, PHASES 1 AND 2. THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM Quarterly Report, 1 Jan. - 31 Mar. 1970
30 Apr. 1970 162 p refs
(Contract AT(30-1)-3824)
(MMM-3824-46; QR-13) Avail: NTIS

The Prototype Mockup Converter No. 2 (PMC-2) completed the 500 hour test program and was installed on the Fueled Prototype Mockup System (FPMS). Fabrication and assembly of PMC-3 was completed. The converter was placed on test and completed the stability conditioning phase of the test. The failure analysis of PMC-1b and PMC-2 converters was completed. The failure of PMC-1b was due to reaction between the thermoelectric leg material and copper from the hot junction electrode. This reaction was caused by sulfur under the iron plating on the electrodes causing a void in the plating through which a copper nodule could grow. The PMC-2 failure was traced to an inverted P leg. Other activities such as performance analysis of PMC-2, design of PMC-3, design of plan for mating converters to isotopic heat sources, and continued test operation of thermoelectric devices are summarized. NSA

N70-42906# Scientific Translation Service, Ann Arbor, Mich.
NUMERICAL CALCULATION METHOD TO SIMULATE THE DYNAMIC AND THERMAL BEHAVIOR OF A COMPRESSIBLE FLUID IN A CLOSED CIRCUIT IN A VARIABLE STATE [METHODE DE CALCUL NUMERIQUE PERMETTANT DE SIMULER LE COMPORTEMENT DYNAMIQUE ET THERMIQUE D'UN FLUIDE COMPRESSIBLE DANS UN CIRCUIT FERME, EN REGIME VARIABLE]
J. C. Rousseau et al Jun. 1970 13 p Transl. into ENGLISH of French CEA Rept. Prepared for Argonne Natl. Lab., Ill.
(ANL-Trans-834) Avail: NTIS

The equations of momentum, continuity, and conservation of energy are applied to a closed circuit traversed by a gas, consisting of energy generators, ducts, exchangers, and blowing equipment. The calculation permits determination of the flow rate, pressure, and temperature of the gas along the entire circuit as well as the wall temperatures as a function of a known variation of the generator power, the blowing output, and the operating conditions of the exchangers. An application is made to determine the behavior of a natural uranium-graphite-gas nuclear reactor for which the exchangers are located below the core-energy generator, when the blowers stop. The calculation permits a prediction of the instabilities and flow inversions in the circuit which can interfere with correct cooling of the power plant. Author (NSA)

N70-42920# Idaho Nuclear Corp., Idaho Falls. Reactor Testing Station.
POST-IRRADIATION RESULTS OF ATR BERYLLIUM SURVEILLANCE PROGRAM Interim Report
G. E. Korth and J. M. Beeston May 1970 25 p refs
(Contract AT(10-1)-1230)
(IN-1397) Avail: NTIS

Results of examinations of specimens from five capsules irradiated to 2 to 5 × 10 to the 21st power m/sq cm (E > 1 MeV) are presented. These are initial results from 64 capsules being irradiated to high fluence to establish the service life for the ATR reflector beryllium. The results gave a linear growth rate of 0.02 to 0.03 percent per 10 to the 21st power n/sq cm fluence. The density change of 0.05 to 0.07 percent per 10 to the 21st power n/sq cm was consistent with the linear change. The compressive yield and ultimate strengths were essentially identical at 4 to 5 × 10 to the 21st power n/sq cm with little plastic ductility, although the specimens had the capacity to absorb compressive impact energy delivered at about 9 kg-m per blow. The swelling threshold decreased with irradiation and appeared at these fluences to be dependent upon the grade of beryllium. Mechanical twinning was a prominent mode of deformation in the compression testing of irradiated beryllium. Author (NSA)

N70-42937# McDonnell-Douglas Astronautics Co., Richland, Wash. Donald W. Douglas Labs.
PLUTONIA CURIA COMPATIBILITY TESTING Quarterly Report, Jan. - Mar. 1970
R. L. Andelin and J. D. Watrous Apr. 1970 14 p refs
(Contract AT(45-1)-2138)
(MDC-G-1689; QR-6) Avail: NTIS

Comparative compatibility test results indicate that relatively pure plutonia-238 is somewhat less reactive with alloys of molybdenum, tungsten, and rhenium than is a less pure form of plutonia-238 after exposure at 1800 C for 2000 hours. Oxygen loss through molybdenum alloy container walls was the same for both fuel forms. Metallic precipitation in the plutonia appears to be a function of purity level. Six refractor metal capsules containing curia-244 completed exposure at 2000 C for 1000 hours. A plutonia-molybdenum cermet exposed at 1800 C for 1000 hours in a closed container was relatively undamaged. A similar cermet exposed at 2000 C for 1000 hours was damaged extensively. Author (NSA)

N70-42949# Los Alamos Scientific Lab., N.Mex.
CALCIUM AS A SOLUBLE GETTER FOR THE CONTROL OF OXYGEN IN SODIUM SYSTEMS
D. N. Rodgers, G. E. Meadows, and J. C. Biery Jun. 1970 13 p refs
(Contract W-7405-eng-36)
(LA-4436) Avail: NTIS

The feasibility of using calcium as a soluble getter for the control of impurity concentration levels in a sodium system was evaluated in a series of experiments in which calcium metal was added to an operating sodium system of 7.5-gal capacity. The system was operated in both the cold-trapped and isothermal modes. In the 125 to 350 C range the (Ca)(O) concentration product was found to vary between 0.13 and 0.22 ppM squared. Thus, 1 ppM calcium in solution will maintain an oxygen concentration below 0.22 ppM in this temperature range. Calcium was also observed to adsorb on stainless steel and nickel surfaces. Surface concentrations on stainless steel between 0.01 and 0.04 mg/sq cm were found. The adsorbed calcium was lightly bound and available for gettering oxygen. In the calcium additions made in these experiments, 80% of the calcium added could not be accounted for and disappeared into unknown sinks. This work indicated that calcium may have promise as a soluble getter of oxygen in sodium. Author (NSA)

N70-43033# Oak Ridge National Lab., Tenn.
ORNL ISOTOPIC POWER FUELS Quarterly Report, Period Ending 31 Mar. 1970
Eugene Lamb Jun. 1970 20 p refs
(Contract W-7405-eng-26)
(ORNL-4567) Avail: NTIS

Equipment for the curium source test was assembled and installed in the test cell. The source capsule was fueled with 956 W(th) (Cm-244)2O3 contained in fourteen pellets. The exposure runs of five sets of compatibility couples were completed. The 1850 C exposure series was completed. Experiments are in progress to measure the rate of transfer of Cm2O3 by volatilization and diffusion in a helium atmosphere. The adiabatic calorimeter for the determination of the heat capacity and stored energy in (Cm-244)2O3 was fabricated and is being assembled. Compatibility couples of (Sr-90)TiO3 are being exposed to 900 and 100 C temperatures to investigate the effect of method of preparation on the compatibility of (Sr-90)TiO3. Author (NSA)

N70-43037# Argonne National Lab., Ill. Materials Science Div.
PILOT-LOT FABRICATION OF ZPPR OXIDE-ROD ELEMENTS
J. E. Ayer, A. G. Hins, and F. D. McCuaig Jan. 1970 25 p refs
(Contract W-31-109-eng-38)
(ANL-7649; DWR-1457) Avail: NTIS

The development and manufacture of oxide-rod fuel elements and gamma-scan standards for the ZPPR reactor are discussed. A total of 52 elements, 30 oxide-rod fuel elements and 22 gamma-scan elements, were made. All UO2 and (U,Pu)O2 pellets were encapsulated in Type 304L stainless steel jackets, with helium at atmospheric pressure. The UO2 and (U,Pu)O2 pellets were fabricated by a cold-press and sinter technique that produced acceptable pellets without centerless grinding. The pellets, produced with a length-to-diamter ratio of 1.5, had a theoretical density of about 95%. A loading technique was developed to protect the outside of the jacket tube and weld zone from plutonium contamination. A special end plug was designed to prevent thinning of the jacket tube wall or an increase of the outside diameter in the welded area, and to produce a finished element of a predetermined overall length. The elements were dimensionally checked, X-rayed, leak detected, and surveyed for alpha contamination on the external surfaces before final acceptance.
Author

N70-43070# Idaho Nuclear Corp., Idaho Falls.
SUBCOOLED BLOWDOWN FORCES ON REACTOR SYSTEM COMPONENTS: CALCULATIONAL METHOD AND EXPERIMENTAL CONFIRMATION
George H. Hanson Jun. 1970 24 p refs
(Contract AT(10-1)-1230)
(IN-1354) Avail: NTIS

The loss-of-coolant accident can make structural demands on a nuclear power reactor system beyond normal requirements. Reliable predictions of the significant transient hydraulic loads are needed for the development of mechanical designs which will ensure coolability of the reactor core, even after such an accident. With one-dimensional subcooled-blowdown digital computer programs such as BURST (Blowdown Under a Rapid Sonic Transient) and WHAM (Water HAMmer), the calculation of the transient hydraulic force on a coolant loop component during blowdown is accomplished more easily and through only one spatial integration by evaluating the remaining terms in the momentum equation. The calculation method was confirmed by experimental blowdown studies. The information obtained using this calculational method is sufficiently reliable for use as forcing-function input for structural dynamics codes to establish the response of the components in a power reactor system to a loss-of-coolant accident.
Author (NSA)

N70-43088# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
SAVANNAH RIVER LABORATORY Co 60 POWER AND HEAT SOURCES Quarterly Progress Report, Jan. – Mar. 1970
C. L. Angerman and C. P. Ross May 1970 15 p refs
(Contract AT(07-2)-1)
(DP-1237) Avail: NTIS

Research and development activities are summarized. Investigations resulted in improved welds made in arc-cast tungsten capsules by increasing weld speed and providing additional cooling to the cap being welded. Wafers of cobalt oxide (CoO) at 90 percent of theoretical density were fabricated by an improved sintering process. High-melting cobalt compounds were found to be not compatible with tungsten and TZM at 1600 C.
Author (NSA)

N70-43127*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 1: RADIATION MEASUREMENTS IN A NUCLEAR ROCKET PROPELLANT TANK MOCKUP USING SIMULATED LIQUID HYDROGEN
H. C. Woodsum and J. Rowland 30 Sep. 1968 200 p refs
(Contract NAS8-20414)
(NASA-CR-102888-Vol-1; WANL-PR(LL)-022-Vol-1) Avail: NTIS CSCL 18F

The radiation environment was investigated on and in a modified 72-inch diameter Saturn 1-B LOX tank suspended above a nuclear rocket critical assembly. Measurements were performed with the tank filled with two different densities of polyethylene to simulate the neutron and photon transport properties in liquid hydrogen. A critical mockup of a NERVA reactor experiment reactor provided a source of neutron and gamma radiation with the desired spectral characteristics. Two different shield mockups were interposed between the reactor and the propellant tank. Measurements of neutron fluxes and fast neutron and gamma dose rates were made. Thermal neutron fluxes and neutron spectra on the surface of the tank in a ground test environment were obtained for use in the evaluation of after-shutdown problems associated with activation of the propellant tank structure and radiation analysis methods. Effects of test cell background were determined experimentally. Comparisons of calculated and measured neutron and gamma radiation levels are included. The two-dimensional discrete ordinates transport code, DOT, was employed to generate neutron fluxes throughout the reactor assembly; and the data processing code, NAGS, generated flux source data for use in the point kernel and Monte Carlo analyses. Calculations in the propellant tank were performed utilizing the KAP-V point kernel code and the FASTER Monte Carlo code.
Author

N70-43128*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 2: ANALYSIS OF RADIATION MEASUREMENTS IN A NUCLEAR ROCKET PROPELLANT TANK MOCKUP USING SIMULATED LIQUID HYDROGEN
L. D. Stephenson, R. G. Soltesz, R. K. Disney, and S. L. Zeigler 30 Sep. 1968 87 p refs
(Contract NAS8-20414)
(NASA-CR-102888-Vol-2; WANL-PR(LL)-022-Vol-2) Avail: NTIS CSCL 18F

For abstract, see N70-43127.

N70-43169# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
EXAMINATION OF STAINLESS-STEEL-CLAD ThO2-UO2 FUEL RODS AND ZIRCALOY-2 CAN AFTER OPERATION FOR 442 EFPD IN THE INDIAN POINT REACTOR, VOLUME 1 Final Report
C. J. Baroch, E. N. Harbinson, and A. V. Munim Aug. 1969 132 p refs
(Contract AT(30-1)-3809)
(BAW-3809-6-Vol-1) Avail: NTIS

Detailed hot cell examinations were performed on 13 ThO2–UO2 fuel rods and one Zircaloy-2 can that were operated in Consolidated Edison's Indian Point Reactor for 442 effective full power days (EFPD). During this operating period, the fuel achieved peak burnups as high as 33,000 MWd/t, and the borated type 304 stainless steel cladding and the Zircaloy-2 can received peak fast neutron fluences (E > 1 MeV). All 13 fuel rods and the Zircaloy-2 can performed very satisfactorily and nothing indicated that these core components could not operate to a considerably higher exposure. The reactor exposure caused no major microstructural changes in the fuel. The lack of microstructural changes indicated that the centerline fuel temperature was probably

less than 1600 C. The ThO2–UO2 fuel operated to exposures of 33,000 MWd/t without introducing localized or general strains in the cladding. No ridging at the pellet interfaces was observed, even in the rod of highest exposure. Author (NSA)

N70-43170# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
POST IRRADIATION EXAMINATION OF THORIA-URANIA FUEL RODS. ISOTOPIC ANALYSIS OF THE FUEL. VOLUME 2 Final Report
W. N. Bishop, S. F. Marsh, R. L. Williams, and G. E. Wolfe Oct. 1969 106 p refs
(Contract AT(30-1)-3809)
(BAW-3809-7-Vol-2) Avail: NTIS

Thirteen fuel rods from Core A of the Indian Point Reactor were analyzed for the isotopic content of selected actinide and fission product elements. Samples of the thoria–urania fuel were dissolved in 13 M nitric–0.05 M hydrofluoric acid, chemically separated and analyzed for the isotopic composition of thorium, uranium, neptunium, plutonium, americium–curium, neodymium, promethium, samarium, and cesium. Neptunium was separated by a solvent extraction procedure in which Np(VI) was extracted into methyl isobutyl ketone–tetraheptylammonium chloride from a hydrochloric acid solution. A sequential separation procedure was developed for the separation of uranium, plutonium, neodymium, promethium, samarium, and americium–curium. This procedure utilizes two extraction chromatography columns and two inorganic ion exchange columns. The separated samples were analyzed by mass, alpha and gamma spectrometry. Author (NSA)

N70-43171# Ohio State Univ., Columbus. Nuclear Development Center.
METALLURGICAL EXAMINATION OF BORON-CONTAINING STAINLESS STEEL CLADDING FROM INDIAN POINT CORE A, VOLUME 3 Final Report
R. W. Staehle, R. A. Wulleart (Battelle Memorial Inst.), J. S. Perrin (Battelle Memorial Inst.), and J. R. Lombard (Battelle Memorial Inst.) Feb. 1970 133 p refs Prepared for Babcock and Wilcox Co., Lynchburg, Va.
(Contract AT(30-1)-3809)
(BAW-3809-8-Vol-3) Avail: NTIS

The type-304 stainless steel cladding from Indian Point Core was examined metallurgically. This cladding was of special interest because it contained 250 + or – 100 ppM boron as distributed poison. The evaluation included visual examination, corrosion tests in boiling HNO_3, potentiostatic polarization tests, creep tests, and electron microscopic examination of thin metal foils and of replicas from fractured surfaces of both irradiated and nonirradiated material. The corrosion and electrochemical tests showed that irradiation greatly increased the corrosion attack at grain boundaries. The mechanical testing and electron metallography showed brittle behavior in the temperature range of 600 C. Author (NSA)

N70-43180 National Lending Library for Science and Technology, Boston Spa (England).
THEORETICAL ANALYSIS OF FLUID VIBRATIONS IN ATOMIC REACTOR FUEL RODS
Kon Nakatame 4 Mar. 1970 20 p refs Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), v. 11, no. 7, Jul. 1969 p 398–405 In ENGLISH and JAPANESE
(NLL-Downey-Trans-449-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

A theoretical analysis was made of fuel rod vibration in a nuclear reactor coolant channel with water flowing parallel to the rod axis. The analysis was based on the fact that the force inducing the fuel rod vibration is the pressure fluctuation of water flowing in the channel, and that this pressure fluctuation travels along the channel with a speed proportional to the mean water velocity. A comparison was made with previous experimental results and it was found that the analysis could explain the observed behavior of rod vibration. Author

N70-43188# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.
MECHANICAL ELEMENTS OPERATING IN SODIUM AND OTHER ALKALI METALS. VOLUME 2: EXPERIENCE SURVEY
D. J. Kniley, W. J. Carlson, E. Ferguson, and O. G. Jenkins 1 Jun. 1970 313 p refs
(LMEC-68-5-Vol-2) Avail: NTIS

The operating history of sodium service mechaniams usad in the following sodium-cooled reactors is presented: the Sodium Reactor Experiment, the Experimental Breeder Reactor 2, the Enrico Fermi Atomic Power Plant, and the Hallam Nuclear Power Facility. Included are mechanism component design characteristics, operating conditions, their operability and maintainability, and the history of component malfunctions with the subsequent repairs or modifications required. It is concluded that an adequate design basis does not presently exist. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N70-41813 Carnegie-Mellon Univ., Pittsburgh, Pa.
THE COHERENT SIGNAL TRANSFER FUNCTIONS OF OPTICAL COMPONENTS
Thomas Paul Vogl (Ph.D. Thesis) 1969 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-18592

The effect of an optical component or subsystem on an incident electromagnetic wave (in the usual scalar wave approximation) is considered and a coherent signal transfer function associated with the propagation derived. The case of pure defocus and lens parameter variation are studied and the invariant properties of the root locus examined. Applications to system layout and design are considered and a simple design executed. Dissert. Abstr.

N70-41840 New Mexico State Univ., University Park.
FINITE TRANSFORM AND FINITE DIFFERENCE SOLUTIONS TO THE RAYLEIGH EQUATION
Stewart Olani Durrant (Ph.D. Thesis) 1969 90 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-19076

The Rayleigh equation for a simple beam with arbitrary initial conditions and/or loading is solved using both finite transform and finite difference methods. The derivation of the finite transform is based on Sturm-Liouville theory. The finite difference recurrence formula is developed using central difference operators. Both the undamped and the lightly-damped cases are considered. Nine examples are considered and the numerical results of the exact finite transform method and the approximate finite difference method are compared. This comparison indicates an excellent degree of accuracy for the finite difference solution. Specific recommendations are made concerning the utility of each approach and the restrictions in their use are noted. Dissert. Abstr.

N70-41885*# Scientific Translation Service, Santa Barbara, Calif.
LABORATORY EQUIPMENT FOR MEASURING THE ELASTIC WAVE VELOCITY IN ROCK SAMPLES AT HIGH

PRESSURES AND TEMPERATURES [LABORATORNAYA USTANOVKA DLYA IZMERENIYA SKOROSTI UPRUGIKH VOLN V OBRAZTSAKH GORNYKH POROD PRI VYSOKIKH DAVLENII I TEMPERATURE]

V. I. Shapoval et al. Washington NASA Oct. 1970 14 p refs Transl. into ENGLISH from the publ. 'Fizicheskiye Svoystva Vestchestva Zemnoy Kory. Geofizicheskiy Sbornik, Vypusk 21' Kiev, Naukova Dumka Press, 1967 p 27–36
(Contract NASw-2035)
(NASA-TT-F-13274) Avail: NTIS CSCL 14B

The data provided by the described equipment help to establish the nature of wave propagation in the crust and upper mantle of the earth. It is found that this ultrasonic equipment can determine the velocity in rock samples with an accuracy of + or − 0.3 to + or 0.5% when the total transit time for elastic waves ranges from 18 to 20 microseconds. Author

N70-41914*# California Univ., San Diego. Dept. of Applied Physics and Information Science.

PHOTOELECTRIC DETECTION OF COHERENT LIGHT IN FILTERED BACKGROUND LIGHT

Carl W. Helstrom [1970] 18 p
(Grant NGL-05-009-079)
(NASA-CR-114160) Avail: NTIS CSCL 20F

The probability of detecting coherent light in the presence of background light that has passed through a narrowband filter of either rectangular or Lorentz frequency characteristic is calculated. Both signal and background fall on a photoelectric surface whose emitted electrons are counted and subjected to a randomized decision procedure that yields a preassigned false alarm probability. Author

N70-41931# Tokyo Univ. (Japan). Inst. for Nuclear Study.

SYSTEMATIC INVESTIGATION OF ULTRA HIGH ENERGY INTERACTIONS, PART 2

T. Nozaki and M. Koshiba Apr. 1970 93 p refs
(SJC-P-70-2) Avail: AEC Depository Libraries

The composition of secondary particles produced in the backward cone of nuclear interactions of 10 to the 12th power eV to 10 to the 13th power eV was investigated by means of a large emulsion stack. The angular distributions in the center of mass system of protons, K + or − mesons and pi + or − mesons were observed to have their respective peaks in the narrow, < or approximately 0.2 radian, angular region around the backward direction. The K + or −/pi + or − ratio in the peak was found to be 0.71 + or − 0.20. The K + or − mesons in the peak are likely to be the decay products of phi mesons produced with small emission angles. Finally with additional experimental data the Aleph isobar proposed previously is examined. Author (NSA)

N70-42002# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.

TRANSMISSION OF NOISE THROUGH STRUCTURES OF COMPLEX SHAPE

P. N. Whitton Feb. 1970 12 p refs
(RD/B/N-1607) Avail: AEC Depository Libraries

A method is proposed for determining the sound pressure level in a gas cavity excited only by transmission of sound into it through its walls. The method is used in a particular reactor configuration to determine the noise transmission between two cavities separated by steel platework. Author (NSA)

N70-42068# Academy of Sciences (USSR), Moscow. Atomic Energy Inst.

GAS DISCHARGE

B. M. Smirnov 1969 72 p refs In RUSSIAN
(IAE-1795) Avail: AEC Depository Libraries

Three types of self-supporting discharge are studied. At low discharge currents, the space charge of the electrons and ions does not affect the properties of the discharge since there occurs potential removal of electrons by ions from the surface of the cathode. This type of discharge is called a Townsend or dark discharge. A discharge that corresponds to higher current densities is called a glow discharge. In a glow discharge, the formation of electrons at the cathode surface is also determined by the potential removal of them by ions, but in this case the space charge of the electrons and ions considerably affects the discharge properties. As the discharge current density increases, a glow discharge transforms into an electric arc. In an electric arc the formation of electrons at the cathode surface is due to thermoelectron and autoelectron emission. NSA

N70-42168*# Southampton Univ. (England). Inst. of Sound and Vibration Research.

THE TRANSMISSION OF SONIC BOOM SIGNALS INTO ROOMS THROUGH OPEN WINDOWS. PART 2: THE TIME DOMAIN SOLUTIONS

P. G. Vaidya [1970] 59 p refs
(Grant NGR-52-025-003)
(NASA-CR-111787) Avail: NTIS CSCL 20A

The time domain extensions of results previously reported are investigated. Expressions for pressure fields inside rooms due to a delta impulse type excitation were obtained, both by using a normal mode type approach and by using a Helmholtz resonator analogy. The results are applied to the specific case of 'N'-wave type excitations. Author

N70-42705*# Michigan Univ., Ann Arbor. Electron Physics. Lab.

CUTOFF CONDITIONS FOR TRANSVERSE CIRCULARLY POLARIZED ELECTROMAGNETIC WAVES IN A FINITE TEMPERATURE ELECTRO-MAGNETO-IONIC MEDIUM

H. C. Hsieh *In its* An Invest. of Nonlinear Interaction Phenomena in the Ionosphere Nov. 1969 10 p refs Repr. from J. Atmos. Terrest. Phys. (Northern Ireland), v. 29, 1967 p 1219–1228 refs (See N70-42701 24-13)
(Grant NsG-696)
Avail: NTIS CSCL 20N

The dispersion relation for wave propagation in a homogeneous, electrically neutral electron gas subject to crossed static electric and magnetic fields is derived using the coupled Maxwell-Boltzmann-Vlasov equations. The cutoff condition for transverse circularly polarized electromagnetic waves is obtained from the derived dispersion relation. The variation of the cutoff frequency with the static electric field, magnetostatic field B sub o, the electron number density N, and the electron gas temperature is discussed. For example it is shown that for a given value of B sub o and N, either a decrease of the electron gas temperature or an increase of static electric field will cause the cutoff frequency of the left-hand circularly polarized wave decreases. A possible application of the theory to the study of electromagnetic wave propagation in the region of ionospheric plasma, where both static electric and static magnetic fields are present, is indicated. Author

N70-42771*# Translation Consultants, Ltd., Arlington, Va.

ELLIPTIC POLARIZATION WHEN LIGHT IS REFLECTED FROM LIQUIDS [ELLIPTICHESKAYA POLYARIZATISYA PRI OTRAZHENII SVETA OT ZHIDOSTEY]

D. V. Sivukhin Washington NASA Oct. 1970 17 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 21, no. 2, 1951 p 367–376
(Contract NASw-2038)
(NASA-TT-F-13329) Avail: NTIS CSCL 20F

The theory of elliptic polarization when light is reflected from a liquid with a monomolecular transition layer on its surface is stated. A comparison is made with an experiment on the assumption that the monomolecular layer consists of anisotropic molecules oriented with the axes of greatest polarizability perpendicular to the surface of the liquid. Author

N70-42831# Army Electronics Command, Fort Monmouth, N.J.
ACTIVE ACOUSTO-OPTIC MODULATORS
Robert Mauro Jul. 1970 65 p refs
(AD-710240; ECOM-3309) Avail: NTIS CSCL 20/1

In recent years there has been considerable interest in the use of acousto-optical interaction phenomena for the modulation, deflection, and Q switching of lasers. This has been due principally to the development of new materials and techniques which have made such devices competitive with the better established mechanical and electro-optic methods. Typically an acousto-optic system consists of an interaction medium onto which a piezoelectric transducer is bonded, and an R.F. power source which excites the transducer producing the required acoustic waves. This report discusses a simplified alternate approach to this problem in which an active ultrasonic oscillator excited by a DC voltage source serves as both the interaction medium and the generator of the ultrasonic waves. Author (TAB)

N70-42832# Wyle Labs., Inc., Huntsville, Ala. Research Staff.
SOUND PROPAGATION AND ATTENUATION CHARACTERISTICS OVER A HEAVILY VEGETATED TERRAIN
S. Paul Pao Jun. 1970 19 p refs
(Contract DAHC04-70-C-0016)
(AD-706845; AROD-8871-1-E) Avail: NTIS CSCL 20/1

The object of the study was to establish methods for predicting sound propagation losses over areas covered with thick vegetation or forest. In dealing with problems in this regime, the concept of layered media boundary condition is of prime importance. The study is being conducted through both analytical and experimental approaches. Author (TAB)

N70-42839# Harry Diamond Labs., Washington, D.C.
A NEW OPTICAL RETROREFLECTOR
Donald J. Mary Jun. 1970 22 p refs
(AD-710222; HDL-TM-70-15) Avail: NTIS CSCL 20/6

A simple retroreflector consisting of two lenses and a plane mirror has been designed. The unit is characterized by low cost and simplicity of fabrication. Although not so compact as a conventional retroreflector, this new design can be made with large apertures and is quite rugged. By etching a reticle pattern on the mirror, the system will permit measurement of rotational speed of objects to which it is attached. Author (TAB)

N70-42936# Honeywell, Inc., Seattle, Wash. Marine Systems Center.
RESEARCH PROGRAM IN ACOUSTIC REVERBERATION
Interim Technical Report, 1 Apr. – 30 Jul. 1970
Robert L. Swarts 18 Aug. 1970 19 p refs
(Contract N00014-69-C-0317)
(AD-710412; Rept-2207; ITR-1) Avail: NTIS CSCL 20/1

Experiments to be carried out in summer and fall of 1970 near Mukilteo, Washington are outlined. The experiments are concerned with gathering data to deduce surface scatter parameters required by Middletons statistical model for acoustic reverberation. The period of stationarity of the surface scatter will also be investigated. Some experimental results of an examination of the kurtosis of volume reverberation data collected during 1969 are included. A comparison of the experimental results with three theoretical cases is made. Author (TAB)

N70-43065# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
MICROWAVE MEASUREMENTS OF PROJECTILE MOTION IN THE BARREL OF THE UTIAS IMPLOSION DRIVEN HYPERVELOCITY LAUNCHER
A. Elsenaar Wright-Patterson AFB, Ohio ARL Apr. 1970 64 p refs
(Contract AF 33(615)-5313)
(AD-709194; UTIAS-TN-145; ARL-70-0073) Avail: NTIS CSCL 19/4

A microwave-Doppler method is applied to measure the velocity of a projectile inside the barrel of the UTIAS Implosion-Driven Hypervelocity Launcher. The microwave-Doppler method and its application for this particular case are discussed in detail. The measurements concentrate on the gas case, in which the driven gas is only a stoichiometric mixture of hydrogen and oxygen, without explosive PETN, for initial pressures between 200 and 600 psi. It is clearly shown that the projectile is accelerated by subsequent pressure pulses caused by multiple implosions inside the chamber. The effect of the subsequent implosions on the motion of the projectile decreases with increasing velocities and for velocities greater than approximately 8000 ft/sec only the first implosion seems to be important. The muzzle velocities in this experiment could be compared with earlier measurements and are in good agreement. A numerical calculation, describing the projectile motion only during the first pressure pulse also agrees with the measurements. Finally, earlier results of muzzle velocity for gas and explosive cases are discussed and some general remarks with respect to possible losses in the driving mechanism are made. Author (TAB)

N70-43154# Brown Univ., Providence, R.I.
THE THEORY OF GENERAL RELATIVITY
Peter J. Westervelt 1970 61 p
(NYO-2262-TA-218) Avail: NTIS

The discussion covers a review of special relativity and the linearized theory of general relativity including linearized equations of motion, the energy-momentum pseudotensor, experimental predictions, general relativistic definition of the center of mass, locally plane gravitational waves, and the sources of gravitational waves. Also included are gravitational radiation, the oscillating neutron star, gravitational radiation from a pulse of light, cosmology, gravitational radiation from a laser, and from a finite pulse. Some exact results from general relativity are also given. NSA

N70-43198*# Philco-Ford Corp., Palo Alto, Calif. WDL Div.
COMPUTER PROGRAM TO PREDICT SPACECRAFT WINDOW DEFORMATIONS AND COMPUTE WINDOW INDUCED ANGULAR DEVIATIONS OF LIGHT RAYS
David M. Kelley and Philip A. Diether Sep. 1970 203 p refs
(Contract NAS2-6044)
(NASA-CR-73477) Avail: NTIS CSCL 20F

Rays may enter at any inclination at the points of a specified grid on the underformed window surface. Window panes are assumed to be originally flat and of uniform thickness. Ray deviations are computed for windows with elliptical, rectangular, and trapezoidal planforms due to given uniform pressures. Deformations for elliptical and rectangular planforms are calculated in the program. Deformations for trapezoidal planforms must be input from punched cards. Deformations for either clamped or simply supported edge conditions may be considered. Ray deviaions can be developed for windows having one or two panes with any given spacing between panes. Angular and translational deviations are reported for each ray. In addition, mean and root mean square deviations of collinear sets of light rays are listed. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N70-41801# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
COHERENT STATE METHOD IN THE PROBLEMS OF HIGH ENERGY HADRON INTERACTIONS
V. A. Matveev and A. N. Tavkhelidze 1970 24 p refs
(JINR-E2-5141) Avail: AEC Depository Libraries

A model of high energy hadron interactions based on the assumption of a coherent nature of the excited states of colliding hadrons is discussed. In the model described, the degeneration of the states is given by a four dimensional relativistic oscillator which takes the role of some collective variable. The wave functions of the hadron coherent states are determined and their properties studied. Models of elastic and inelastic high energy hadron interactions are considered. The coherent state vectors are used for the factorization of the scattering amplitudes satisfying a subsidiary integral representation. NSA

N70-41814 Wisconsin Univ., Madison.
AN ANALYSIS OF MESON PRODUCTION UTILIZING A CHIRAL SU(3) CROSS MULTIPLICATION SU(3) PHENOMENOLOGICAL LAGRANGIAN
Leaf Turner (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-12425

Extending the Weinberg covariant derivative technique for the study of multiple soft meson processes, a chiral SU(3) cross multiplication SU(3) phenomenological Lagrangian is derived with which the meson-meson scattering, meson-baryon scattering, and single meson production are analyzed. The vector and axial vector currents satisfy the Gell-Mann current algebra hypothesis. A chiral symmetry-breaking term, which would be absent in the limit of zero meson mass, appears in the Lagrangian to guarantee partial conservation of the axial vector current. The vector current is strictly conserved. Only tree diagram contributions are utilized in calculating amplitudes. It is discovered that the only ambiguity in physical meson-meson scattering amplitudes, appearing as the parameter xi, is also the only one present in the single meson production amplitudes. This uncertainty is shown to be related directly to the arbitrariness of the chiral symmetry-breaking mechanism. Dissert. Abstr.

N70-41831# Stanford Linear Accelerator Center, Calif.
STATUS OF HUMMINGBIRD FILM DIGITIZERS
John L. Brown May 1970 17 p Presented at 2d Intern. Colloq. on PEPR, Cambridge, Mass., 5–7 May 1970 Supported in part by AEC
(SLAC-PUB-752; CONF-700519-1) Avail: NTIS

The status of CRT film digitizers at SLAC is briefly reviewed. The hardware and computer configuration are described including the IBM 360/91, Hummingbird 2, and Hummingbird 3 with TV display. Experience with the system on three experiments is discussed including muon + pion scattering spark chamber experiment cosmic ray spark chamber experiment, and streamer chamber K sup 0 decay experiment. NSA

N70-41839 Rice Univ., Houston, Tex.
EXPERIMENTAL STUDIES OF SPIN DEPENDENCE IN p, He-3 ELASTIC SCATTERING
Diana Hartridge McSherry (Ph.D. Thesis) 1969 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-19319

Spin dependent phenomena, including He-3 recoil polarization and spin correlation effects, were studied for p, He-3 elastic scattering in the 4 to 11 MeV energy range. Data were taken at four angles using an He-3 target polarized by the technique of optical pumping and an unpolarized proton beam. The spin correlation effects were measured at two angles at 8.8 MeV using both polarized beam and polarized target. A phase shift analysis, including cross section, proton polarization, He-3 polarization, and spin correlation data was done for five energies from 4.0 to 10.7 MeV. The solution space for various phase shifts and mixing parameters was also studied in detail, including consideration of possible correlations between scattering parameters. Dissert. Abstr.

N70-41842 Louisiana State Univ., New Orleans.
A MODIFIED SEMIEMPIRICAL MOLECULAR ORBITAL METHOD FOR COORDINATION COMPLEXES
Leonce E. Harris, Jr. (Ph.D. Thesis) 1969 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-18525

A modified method of performing MWH calculations was developed incorporating the interatomic coulombic energy. The inclusion of the terms was rationalized by making systematic approximations to the full Hamiltonian for the system. Additionally, the effect of the surrounding media on charged complexes was taken account of by a constant potential called a crystal potential. The Mulliken-Wolfsberg-Helmholz expression as modified by Cusachs was used for the off-diagonal elements with a further parameter based on the nonproportionality of the kinetic energy. Dissert. Abstr.

N70-41848 Drexel Inst. of Tech., Philadelphia, Pa.
NEUTRON INDUCED REACTION STUDIES IN CsI(Tl) BY PULSE SHAPE DISCRIMINATION
Arthur Joblin (Ph.D. Thesis) 1969 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-18247

Reactions induced in cesium iodide by neutrons in the energy range 13 - 15 MeV were studied using an improved spectrometer system which employs a two parameter analyzer to identify both particle type and energy. Particles of known energy were used to accurately establish the CsI response function over the entire energy range of interest and for the particles of interest. The experimental response function for protons is found to be nonlinear at high energies but this was shown to be due to the strong variation in scintillation decay time with particle energy. An associated alpha particle system was used to measure the neutron flux and to establish absolute cross sections for the neutron induced reactions in CsI. The energy spectra for alphas, protons, and deuterons are analyzed in terms of compound nuclear and direct reaction mechanisms using an optical model potential to calculate compound nucleus formation cross sections. Dissert. Abstr.

N70-41849 Arizona Univ., Tucson.
LAMBDA HYPERON-K MESON PRODUCTION IN PION-PROTON COLLISIONS NEAR THRESHOLD
James Jordan Jones (Ph.D. Thesis) 1969 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-18330

Examples of the reaction were selected from other possible final states on the basis of a predetermined signature in a system of scintillation counters. Events thus selected were analyzed by means of optical spark chambers which provided information on the trajectories of the incident pion and the charged decay products of the Lambda hyperon or kaon. For each such event, the incident pion momentum was measured to approximately 1 MeV/c using a spark chamber spectrograph located in the incident pion beam. Analysis of the events near threshold indicates pure s-wave Lambda hyperon + kaon production immediately above threshold and substantial p-wave contribution when the center of mass momentum reaches 100 MeV/c. Dissert. Abstr.

N70-41869# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
DOUBLE SCATTERING IN THE PROCESSES OF QUASI-ELASTIC INTERACTION OF PI MESONS WITH DEUTERONS
A. V. Tarasov and Ch. Tseren 1970 14 p refs In RUSSIAN
(JINR-P2-5078) Avail: AEC Depository Libraries

The contribution of the double scattering amplitudes to the cross section of quasi-elastic scattering of pion-mesons by deuterons and the cross section of charge exchange of pion-mesons by deuterons in the mean energy region is investigated.
Author (NSA)

N70-41870# Tokyo Univ. (Japan). Inst. for Nuclear Study.
DETAILED INVESTIGATION OF AN 80 TeV NUCLEAR INTERACTION
T. Nozaki Apr. 1970 86 p refs
(SJC-P-70-3) Avail: AEC Depository Libraries

An 80-TeV nuclear interaction of type (15 + 15 + 49) proton detected in a large emulsion stack was analyzed in detail. The target diagram of charged secondary particles and gamma rays in the extreme forward cone together with their energy estimates was found to be consistent with the production of an Aleph baryon and its subsequent decay into (proton + phi-meson) in the extreme forward cone. The masses of the wide angle secondary charged particles were identified and the results were found to be consistent with the production of an Aleph baryon decaying into (proton + phi-meson) in the extreme backward cone of the center of mass system.
Author (NSA)

N70-41877 Colorado Univ., Boulder.
RESONANCE PRODUCTION IN PION(−) PROTON YIELDS PION(−) PION(−) PION(+) PROTON AT 6.7 GeV/c
Juergen Rudolph von Krogh (Ph.D. Thesis) 1969 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-19577

Resonance production in the reaction pion(−) proton yields pion(−) pion(−) pion(+) proton at a beam momentum of 6.7 GeV/c was studied in the 30 inch MURA hydrogen bubble chamber from a total of 100,000 exposures. The cross section for the above reaction was determined as sigma = (1.3 plus or minus 0.2) mb. As expected at this energy, high peripherality was noted. Bosons produced are A sub 1 (1060), A sub 1.5 (1180) and A sub 2 (1305), mainly decaying inton pion(−) proton(0), and A sub 3 (1640), mainly decaying into pion(−) f(0). These A-mesons cannot be explained away with low mass enhancements due to one-particle exchange diagrams. A spin-parity analysis, fitting decay-angular distributions, was made. Spin-parity for the A sub 1 is consistent with the 1(+); for the A sub 1.5 0(−) and 2(+) can be ruled out; spin-parity for the A sub 2 is consistent with 2(+), however, 1(+) and 2(−) cannot be excluded. Baryons produced are N(1525) and N(1688), mainly going into pion(−) Delta (++). The width for the N(1688) seems to be lower than generally obtained from the phase shift analysis.
Dissert. Abstr.

N70-41879# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ATMOSPHERIC NEUTRINOS AND THE PROPERTIES OF THE NEUTRINO INTERACTIONS AT HIGH ENERGIES
Z. Kunszt and G. Vesztergombi (Central Res. Inst. for Phys., Budapest) 1970 10 p refs
(JINR-E2-5092) Avail: AEC Depository Libraries

Assuming that the intermediate vector boson exists, the structure functions in the deep inelastic neutrino Nucleon scattering exhibit scale invariant behavior and that the weak interactions can be calculated as first order perturbation up to 100-1,000 TeV in the neutrino energies, the mu-neutrino-induced muon-flux is estimated numerically. With a dip in the energy greater than 0.8 in the total cross sections, contradiction with the experimental muon-flux obtained in cosmic ray measurements is obtained. The scale invariance of the nuW sub 2 MW sub 1 structure functions restricts the mean fractional energy transferred to prompt muons produced in the inelastic reactions.
Author (NSA)

N70-41899# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
ANISOTROPIC SOURCES IN TWO-DIMENSIONAL TRANSPORT THEORY
Bruce W. Crawford and Jack P. Friedman [1969] 14 p refs Presented at Am. Nucl. Soc. 16th Ann. Meeting, Los Angeles, 28 Jun.−2 Jul. 1970
(Contract W-31-109-eng-52)
(KAPL-P-3889) Avail: NTIS

A method for treating anisotropy in multigroup transport theory is presented. Neutron scattering in each energy group is assumed to have the mathematical appearance of isotropic scattering. Extensions necessary for treating a Legendre polynomial expansion of the in-group scattering kernel are mentioned. Attention is confined to first-order spherical harmonics source moments.
NSA

N70-41901*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF NUMERICAL CAPTURE CROSS SECTIONS WITH EXPERIMENTAL REACTION CROSS SECTIONS FOR NH3(+) + NH3
John V. Dugan, Jr. [1970] 7 p refs Presented at 23d Gaseous Electron. Conf., Hartford, 20−23 Oct. 1970; sponsored by Am. Phys. Soc. and the United Aircraft Res. Labs.
(NASA-TM-X-52903) Avail: NTIS CSCL 20H

Numerically calculated capture cross sections are compared with Ryan's experimental reaction cross sections for NH(+)3 + NH3 yields NH(+)4 + NH2. The numerical reaction cross section is obtained assuming that vibrationally excited NH(+)3 do not react. Theory and experiment agree satisfactorily from thermal energy to nearly 1 eV although their slopes are slightly different and both steeper than Langevin.
Author

N70-41909 Massachusetts Univ., Amherst.
OSCILLATORY PHOTOCONDUCTIVITY IN WURZITE CADMIUM SULFIDE
David Tai-Yu Wei (Ph.D. Thesis) 1969 162 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-19084

The spectral response of photoconductivity of CdS at 4.2 K has oscillatory structure with period equal to an LO-phonon energy. When incident monochromatic light is modulated with a mechanical chopper, three major series of oscillations are observed. Two series appear in the amplitude of ac-photocurrent. Their minima correspond to multiples of the energy of LO-phonons, plus the ground state of exciton A(A-series) or exciton B(B-series) respectively. A third series of oscillations appears in the phase of ac-photocurrent. Its minima are displaced slightly from those of A-series. The amplitude oscillation is identified as due to oscillation of photoconductive quantum efficiency. On the other hand, the phase oscillation is due to the oscillation in photoconductive lifetime. When a second beam of unchopped monochromatic light near I2 absorption line (4867 A) is superimposed on the chopped beam, the A-series of oscillation is strongly quenched in a group of samples.
Dissert. Abstr.

N70-41921# Ceskoslovenska Akademie, Rez. Ustav Jaderneho Vyzkumu.
SEMILEPTONIC DECAYS OF HYPERONS
J. Dittrich and F. Janouch 1970 29 p refs
(UJV-2400-F) Avail: NTIS

The semileptonic weak decay of polarized hyperons is investigated. The decay probability and correlations between momenta and spins of participating particles are calculated relativistically.
Author (NSA)

N70-41923# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
PHOTOPRODUCTION OF PSEUDOSCALAR MESONS ON PROTONS AND MIXING ANGLE OF ISOSINGLETS eta 1 AND eta 8
N. A. Kobylinskii 1970 9 p refs In Russian; English Summary
Presented at Seminar at Kiev

(ITF-70-19) Avail: AEC Depository Libraries

The processes of the photoproduction of neutral pion and eta mesons on protons are considered within the framework of a model taking into account poles and cuts with the aim of definition of the mixing angle of isotopic singlets eta sub 1 and eta sub 8. The possibility is shown of definition of sign of amplitudes and of widths of the two photon decays of pseudoscalar mesons in their photoproduction on protons. Author (NSA)

N70-41926# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.

DUALITY AND THE TOTAL CROSS SECTIONS OF MESON-NUCLEON SCATTERING IN THE QUARK MODEL

A. P. Kobushkin 1970 8 p refs Presented at Seminar at Kiev

(ITK-70-24) Avail: AEC Depository Libraries

The possibility of using dual diagrams for the problem of finding the relations between the total cross sections of meson-nucleon scattering is studied. It is shown that the duality, crossing symmetry and analyticity on s, t, u are in contradiction in this model. Eliminating the requirement of the crossing symmetry on s reversible reaction u of the scattering amplitude and preserving the duality and analyticity, one gets the relations between the total cross sections which are compared with experiment. Author (NSA)

N70-41943*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INELASTIC SCATTERING OF PROTONS FROM In-115

Regis F. Leonard [1970] 8 p refs Presented at 1970 Fall Meeting of the Div. of Nucl. Phys. of the Am. Phys. Soc., Houston, Tex., 15 – 17 Oct. 1970

(NASA-TM-X-52908) Avail: NTIS CSCL 20H

The inelastic scattering of 19.98 MeV protons from In-115 was studied using the proton beam from the Berkeley 88-inch cyclotron. The experiment was carried out using a 0.25 mg/sq cm, isotopically enriched target. The overall energy resolution of the experiment was approximately 30 KeV. This resolution made it possible to obtain some information concerning individual members of the collective multiplets which arise from coupling of the odd proton-hole of In-115 to the excited states of the even-even tin core. For purposes of comparison, the scattering of 20 MeV protons from Sn-116 (the proposed core) was also studied. Energy spectra and angular distribution data are shown. Author

N70-41945*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE EFFECT OF ELECTRONS, PROTONS AND ULTRAVIOLET RADIATION ON PLASTIC MATERIALS

Evelyn Anagnostou and Adolph E. Spakowski [1970] 3 p ref Presented at 8th Photovoltaic Specialists Conf., Seattle, 4 – 6 Aug. 1970

(NASA-TM-X-52872) Avail: NTIS CSCL 20H

The plastic films Aclar, Kapton, and Teflon-FEP were irradiated with ultraviolet light, electrons, and protons. Mylar with Astro Epoxy was irradiated by UV and Mylar by electrons and protons. FEB-adhesive combinations were subjected to UV. Changes in transmission were measured. All films coated with adhesives were darkened by UV. Kapton and FEP are most resistant to radiation, both UV and particulate, and Aclar becomes very brittle. Mylar is darkened by electrons but not affected by protons. The results are applicable to work in solar cell cover materials. Author

N70-41972# California Inst. of Tech., Pasadena. Antenna Lab.

NEW EQUATION OF MOTION FOR CLASSICAL CHARGED PARTICLES Scientific Interim Report

T. C. Mo and Charles H. Papas Jan. 1970 13 p refs

(Grant AF-AFOSR-1400-68)

(AD-709235; AFOSR-70-1226TR) Avail: NTIS

A new equation of motion is proposed for classical charged particles, which is free from the well-known difficulties of Dirac's equation, is intuitively sound, and predicts reasonable radiation damping. Author (TAB)

N70-41986# Rochester Univ., N.Y. Nuclear Structure Research Lab.

SHELL MODEL STRUCTURE OF Bi-208

W. P. Alford, J. P. Schiffer, and J. J. Schwartz Aug. 1970 49 p refs

(UR-NSRL-36) Avail: Issuing Activity

The level structure of Bi-208 was investigated using both stripping and pickup reactions. The Pb-207(He-3,d) and Pb-207 (alpha,t) reactions permit the identification of a series of doublets arising from the coupling of a proton in the h sub 9/2, F sub 7/2, i sub 13/2, f sub 5/2, and P sub 3/2 single particle states with a neutron hole in the p sub 1/2 shell. The 209(d,t) and Bi-209 (He-3, alpha) reactions populate the multiplets arising from coupling of a neutron hole in the p sub 1/2 shell. The Bi-209(d,t) and Bi-209 (He-3, alpha) reactions populate the multiplets arising from coupling of a neutron hole in the p sub 1/2, f sub 5/2, p sub 3/2, i sub 13/2, f sub 7/2, and h sub 9/2 states with a proton in the h sub 9/2 shell. A detailed analysis shows that the total strength in each multiplet is close to that for the corresponding single-particle or single-hole transition on Pb-208. In addition to the strong transitions leading to states of these multiplets, some relatively weak transitions are observed which provide a measure of the mixing of different configurations. The structure and purity of the particle-hold multiplets below about 3 MeV excitation is in good agreement with shell model calculations. Author

N70-41989# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

CHECKING T-INVARIANCE IN N-N SCATTERING (REVIEW)

R. Ya. Zulkarneev 1970 28 p refs In RUSSIAN

(JINR-P1-5056) Avail: AEC Depository Libraries

The results of the investigation of T-invariance in N–N interaction are reviewed. Possible ways of checking T-invariance are considered. Experimental results are listed and their critical analysis is performed. Author (NSA)

N70-41999*# Gulf General Atomic, San Diego, Calif.

NEUTRON CAPTURE CROSS SECTIONS OF MOLYBDENUM, TANTALUM, AND U 238 Final Report

S. J. Friesenhahn, W. M. Lopez, M. P. Fricke, D. G. Costello, and A. D. Carlson 5 Jun. 1970 94 p refs

(Contract NAS3-11844)

(NASA-CR-72745; GA-10194) Avail: NTIS CSCL 20H

Absolute neutron capture cross sections for natural molybdenum, tantalum, and U-238 were measured from approximately 1 to 1000 keV energy using the time-of-flight technique. The neutron flux spectrum was monitored with He-3 proportional counters that were calibrated against measurements based on the B-10(neutron,alpha)Li-7 cross section below 80 keV and on the neutron + proton scattering cross section at higher energies. The measured energy variation of the capture cross sections above 80 keV relies solely upon the neutron + proton cross section; the cross sections are normalized directly to resolved resonances at low (eV) energies. Author

N70-42007# Joint Inst. for Nuclear Research, Dubna (USSR).

ON COLLECTIVE BEAM ACCELERATION

V. N. Tsytovich 1970 10 p refs In RUSSIAN

(JINR-P9-5091) Avail: AEC Depository Libraries

The possibilities of acceleration of plasma bunches and relativistic electron rings using the action of relativistic electron beams are discussed. The acceleration due to the coherent Cerenkov and coherent transitional radiation is considered. Author

N70-42009# National Bureau of Standards, Washington, D.C. Center for Radiation Research.
PHOTONUCLEAR REACTIONS
Evans Hayward Aug. 1970 45 p refs
(NBS-MONOGRAPH-118) Avail: NTIS

Photonuclear reactions in the approximate energy range 10 to 30 MeV are reviewed. Various sum rules are discussed and applied to experimental data. Several different theories are described and their predictions compared with experiment, and open questions and discrepancies are pointed out. Author

N70-42026*# Brown Engineering Co., Inc., Huntsville, Ala. Physical Sciences Research Lab.
CAVEAT: A REVISED VERSION OF THE GENERAL PURPOSE MONTE CARLO PROGRAM, COHORT. VOLUME 1: THEORY AND TECHNIQUES
N. R. Byrn Apr. 1970 66 p refs Revised
(Contract NAS8-20166)
(NASA-CR-102878; SE-290-Vol-1-Rev) Avail: NTIS CSCL 20H

The revision to a general purpose Monte Carlo computer code for neutron, gamma, and secondary gamma radiation transport calculations is presented. The code is written in the FORTRAN 4 language and was run on the IBM 7094, IBM 360, and UNIVAC 1108 computers. CAVEAT is a revised version of the COHORT program, with additional features such as time dependence, real atmosphere model for air transport, variable dimensioning, and, for third generation machines, a pass option which allows complete execution of a given problem, from source particle generation to fluence calculation. Author

N70-42027*# Brown Engineering Co., Inc., Huntsville, Ala. Space and Military Systems Div.
CAVEAT: A REVISED VERSION OF THE GENERAL PURPOSE MONTE CARLO PROGRAM, COHORT VOLUME 2: USERS' MANUAL
N. R. Byrn Aug. 1969 128 p Revised
(Contract NAS8-20166)
(NASA-CR-102877; SE-290-Vol-2-Rev) Avail: NTIS CSCL 20H

The Users' Manual describes the input format of each of the CAVEAT routines, data file definition, and proper use of the pass option. Suggestions on the proper use of CAVEAT are included. Author

N70-42043# Syracuse Univ., N.Y. Dept. of Physics.
THEORY OF PHOTONS AND ELECTRONS ON NULL PLANES
F. Rohrlich Jul. 1970 33 p refs Sponsored in part by NSF
Avail: Issuing Activity

The field theory is developed first classically and then as a quntum field theory in the Dirac picture and in the Heisenberg picture. The apparent disadvantage of now having field equations which are nonlocal, is by far offset by the following advantages: (1) The electron field is fully described. (2) There is no gage problem. (3) The formulation is ideally suited for the use of current algebras, high energy limits, and for laser theory. The computation of S-matrix elements requires new Feynman rules. Author

N70-42061# Brookhaven National Lab., Upton, N.Y. Information Div.
NEUTRON CROSS SECTIONS OF CADMIUM ISOTOPES
V. P. Vertebny et al Jan. 1970 5 p Transl. into ENGLISH from At. Energ. (Moscow), v. 27, no. 4, 1969 p 349
(BNL-TR-323) Avail: NTIS

For the study of absorber burnout the total neutron and scattering cross sections of Cd-111, Cd-112, Cd-114, and Cd-116 were measured. These cross sections are given, and the experimental techniques are described. NSA

N70-42063# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
METHOD OF COHERENT STATES AND DIAGRAM TECHNIQUE FOR DUAL AMPLITUDES
A. N. Kvinikhidze, (Tbilisi State Univ.), B. L. Markovski, D. Ts. Stoyanov, and A. N. Tavkhelidze 1970 24 p refs
(JINR-E2-5182) Avail: AEC Depository Libraries

A factorization of the dual amplitudes based on the method of coherent states is obtained. Diagram technique for construction of N-particle dual amplitudes by using a finite number of operators is investigated. Author (NSA)

N70-42070# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
PHOTOPRODUCTION ON NEUTRAL PSEUDOSCALAR MESONS ON NUCLEI
N. A. Kobylinskii 1970 9 p refs In RUSSIAN; ENGLISH summary Presented at Seminar at Kiev
(IFA-70-21) Avail: AEC Depository Libraries

The processes of the meson photoproduction on nuclei are considered in a model taking into account poles and cuts parameters which are connected in the impulse approximation with those of contributions from these singularities to the amplitude of the meson photoproduction on nucleons. The possibility is shown of definition of the relative sign of Coulomb and Regge amplitudes in the processes of the coherent meson photoproduction on nuclei with zero isospin. Author (NSA)

N70-42071# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimentalnoi Fiziki
HIGH ENERGY PROTONS DURING ABSORPTION OF MUONS BY EMULSION NUCLEI
A. O. Vaisenberg, E. D. Kolganova, and N. V. Rabin 1969 27 p In RUSSIAN; ENGLISH summary
(ITEF-707) Avail: AEC Depository Libraries

The 25-MeV proton spectrum of emitted heavy nuclei of the AgBr emulsion is studied at the capture of stopped negative muons. It is shown that the number of the fast secondary protons is (3.16 + or − 0.34) × .0001 and (4.7 + or − 1.1·) × .00001 per one capture for proton energies more than 25 and 40 MeV, respectively. The background of the pion stars is studied in detail. The value of the background of one-prong stars with protons of E sub p > or = to 25 MeV and E sub p > or = to 40 MeV does not exceed 8% and 30%, respectively. Author (NSA)

N70-42085# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
EFFECT OF 1-MeV ELECTRON IRRADIATION ON MOS STRUCTURES. MECHANISM OF FORMATION AND THERMAL NEUTRALIZATION OF THE SPACE CHARGE
K. Saminadayar and J. Bernard 1969 17 p refs In FRENCH Presented at the Conf. on Properties and Use of MOS Structures, Grenoble, France, 17 − 20 Jun. 1969
(CEA-CONF-1508; CONF-690640-1) Avail: AEC Depository Libraries

Transistors and capacitors of very simple geometry, formed with a layer of wet thermal silica and a layer of aluminum, were irradiated by 1-MeV electrons. The threshold potential of the MOS transistors and the capacity and conductance of the MOS capacitors were measured. The phenomena of formation of the space charge zone with both continuous and pulse polarizations are presented. Mechanism of the space charge annealing during the thermal annealing process is explained. Author (NSA)

N70-42143# Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center.
THE USE AND TESTING OF Al, Fe, Ni, Cu, AND Pb

SECONDARY GAMMA RAY PRODUCTION DATA SETS FROM THE POPOP4 LIBRARY

W. E. Ford, III and D. H. Wallace 1 Jul. 1970 219 p refs
(Contract W-7405-ENG-26)
(AD-709459; CTC-20) Avail: NTIS CSCL 20/8

Aluminum, iron, nickel, copper, and lead secondary gamma-ray yield data sets for gamma-rays resulting from neutron capture and inelastic scattering reactions were evaluated by comparing calculated secondary gamma-ray pulse height spectra with spectra measured at the Tower Shielding Facility. The calculated spectra were obtained by using a discrete ordinates transport code to calculate the secondary gamma-ray angular flux resulting from the exposure of slabs of the materials of interest to bare, cadmium-filtered, boron-filtered, and thermal neutron beams from the TSR-II reactor and then folding the angular flux into pulse height spectra. Author (TAB)

N70-42170*# Pittsburgh Univ., Pa. Dept. of Chemistry.
OSCILLATOR STRENGTH OF THE RESONANCE TRANSITIONS OF GROUND-STATE N AND O

Chorng-Lieh Lin, David A. Parkes, and Frederick Kaufman 4 Aug. 1970 19 p refs
(Grants NGL-39-011-002; DA-ARO(D)-31-124-G983)
(NASA-CR-114244; SRCC-135) Avail: NTIS CSCL 07D

Multiplet oscillator strengths for the resonance triplets of N and O were determined using the line absorption method and measuring atom concentrations by chemical titration. For the NI triplet at 1200A, the strength equals 0.87 + or − 0.20, and excellent internal agreement was obtained among the separately measured absorption oscillator strengths of the three lines. A value of (3 + or − 1) times 10 to the −11th power cu cm/sec is required for the rate constant of the N + NO yields N2 + O reaction in the analysis of the data. For the OI triplet near 1300 A, the apparent multiplet oscillator strength increased sharply and reproducibly from 0.19 to 0.42 when the diluent gas in the discharge light source was changed from Ar to He, which indicates that excitation transfer is a major source of excitation in such Ar−O2 resonance lamps. The larger oscillator strength obtained with He-O2 light sources is in excellent agreement with results of lifetime measurements by other workers. Author

N70-42209 National Lending Library for Science and Technology, Boston Spa (England).
CRITICALITY GUIDE. PART 1: INTRODUCTION TO CRITICALITY. PART 2: PRACTICAL RULES

8 Jun. 1970 185 p ref Transl. into ENGLISH of French report CEA-R3114
(NLL-LB/9/2620-(9091.9F); CEA-R3114) Avail: Natl. Lending Library, Boston Spa, Engl.: 18 NLL photocopy coupons

Concepts of neutron physics are explained simply and intuitively. The method of the limiting solid angle is explained, and simple formulae are proposed for ovaluating interaction between fissionable units. The general principles used in the nuclear safety design study of a nuclear installation using fissionable materials are given. Practical rules and critical mass and geometry curves, as well as all the numerical values required for normal criticality calculations, are provided for plutonium and uranium of various enrichments. Author

N70-42214# Texas Christian Univ., Fort Worth. Dept. of Physics.
SPECTROSCOPIC DETERMINATION OF INTERMOLECULAR FORCES Final Report, 1 Jun. 1966 − 1 Jul. 1970

C. E. Blount 30 Jun. 1970 52 p refs
(Contract N00014-66-C-0195)
(AD-709998) Avail: NTIS CSCL 7/4

The absorption spectra of mercury in argon, krypton, xenon, and nitrogen were obtained for deposit temperatures from 4K to 20K. The spectra exhibit multiple structure for argon, krypton, and xenon host but only a narrow band and a broad band for nitrogen as a host. These results can be explained by assuming the existence of relatively isolated mercury atoms in the host and interacting pairs of mercury atoms trapped at non-neighboring sites in the host. Abstracts of all experiments conducted to determine intermolecular forces spectroscopically are included. Author (TAB)

N70-42220*# Pittsburgh Univ., Pa. Space Research Coordination Center.
EXCITATION OF N2 AND N2(+) SYSTEMS BY ELECTRONS. 2: EXCITATION CROSS SECTIONS AND N2 1PG LOW PRESSURE AFTERGLOW

D. E. Shemansky and A. L. Broadfoot (Kitt Peak Natl. Obs., Tucson, Ariz.) 25 Sep. 1970 87 p refs
(Grant NGL-39-011-002)
(NASA-CR-114190; SRCC-140) Avail: NTIS CSCL 20H

Quantitative optical measurements of the N21P, 2P, and N2(+) meinel systems excited by electrons, have allowed measurement of transition probabilities, excitation cross-sections, and afterglow effects. The excitation cross-sections were determined relative to that of the N2(+) (0,0) first negative band. The estimated total peak electron cross-section of the B 3Pi sub g state is 1.2 × 10 to the minus 16 centimeters squared, about a factor of 2 larger than other recently published estimates. The total peak cross-section of the C 3Pi sub u state is estimated to be 3.8 × 10 to the minus 17 centimeters squared. Author

N70-42257*# Nebraska Univ., Lincoln. Dept. of Physics.
DIFFERENTIAL SCATTERING WITH CHARGE TRANSFER TO THE 2S STATE OF HYDROGEN FROM H(+)−He AND H(+)−Ar COLLISIONS

David H. Crandall (Ph.D. Thesis) Aug. 1970 186 p refs
Sponsored in part by NASA, NSF, and Nebraska Res. Council
(NASA-CR-114270) Avail: NTIS CSCL 20H

For collisions of protons with helium and argon target gases, the differential cross sections for total scattering, the probabilities of charge transfer forming a hydrogen atom, and the probabilities of charge transfer forming a hydrogen atom in the 2s state were measured. The measurements were differential in the angle to which the incident particle was scattered and were made for the range of incident proton energies between 3 and 20 keV. Scattering angles between 1 and 7 deg were used. Author

N70-42270*# Pittsburgh Univ., Pa. Space Research Coordination Center.
EXCITATION OF N2 AND N2(+) BAND SYSTEMS BY ELECTRONS. 1: ABSOLUTE TRANSITION PROBABILITIES

D. E. Shemansky and A. L. Broadfoot (Kitt Peak Natl. Obs.) 25 Sep. 1970 38 p refs
(Grant NGL-39-011-002)
(NASA-CR-114165; SRCC-139) Avail: NTIS CSCL 20H

The determination of the absolute transition probabilities for the N2 first positive (1P) and N2(+) Meinal (M) systems is described, and tables of values for the N2 second positive (2P) and N2(+) first negative (1N) systems given. Estimates of the relative populations of the excited levels are obtained as a by-product of the analysis of the observed spectra for the determination of transition probabilities. These values, converted into apparent relative population rates, are examined and utilized to determine the excitation and deactivation processes affecting the N2 1P and N2(+) M excited states. Measurements at various gas pressures, electron energies, and electron currents indicated that there was not a simple relation between the observed relative populations of the vibrational levels and the excitation rate of ground state molecules to these levels. The process affecting the excited states of both the N2 1P and N2(+) M systems in fact could not be interpreted without combined steady state and transient measurements. Electron

excitation cross sections of the N2 1P, 2P and N2(+) M systems determined relative to the established N2(+) 1N cross section are presented. Author

N70-42297*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
INELASTIC MOLECULAR SCATTERING
Roger William Fenstermaker (Ph.D. Thesis) 1970 134 p refs
(Grants NGL-50-002-001; NSF GB-16685)
(NASA-CR-110791; WIS-TCI-392X) Avail: NTIS CSCL 20H

A molecular beam study of the change in relative populations of the lower vibrational states of CsF upon collision with CO2 is reported. Focused beams of CsF in specified vibrational-rotational states were prepared by means of a previously developed molecular beam electric resonance method employing microwave stimulated emission combined with quadrupole electric focusing fields. The ratio of populations of the two lowest vibrational states was measured for one (J,M) = (1,0) rotational state of CsF. This ratio was determined for the direct (unattenuated) CsF beam and then for the CsF beam attenuated by the scattering partner. The result was a small, but statistically significant increase (contrary to expectation) in the population ratio due to scattering. This observation is considered to serve as evidence of inelastic scattering. Reprints of two previously published papers are included: (1) The sudden approximation was used to produce numerical calculations of the angular distributions and energy dependence of rotational excitation cross sections for diatomic molecules in collision with atoms. (2) The equivalence of the Born approximation and the first-order time-dependent perturbation approximations is demonstrated for such systems, and analytical formulas for the rotational transition probabilities are presented. Author

N70-42303# Kernforschungszentrum, Karlsruhe (West Germany).
KINETICS OF THE ELECTRON BEAM COOLING IN STORAGE RINGS FOR HEAVY PARTICLES
Ya. S. Derbenev et al [1970] 46 p refs Transl. into GERMAN from the Russian In GERMAN
(KFK-TR-315) Avail: AEC Depository Libraries

The kinetic characteristics of the method of electron beam cooling in storage rings for heavy particles were investigated. A kinetic equation for the particle beam, which periodically passes the secondary electron flux, was given on the basis of the Landau collision integral for the Coulomb interaction. In addition to the electron collisions, the scattering on coherent fluctuations (nonthermodynamic origin) of the space charge of the electron beam and on the atoms of the residual gas was calculated. The final kinetic equation is the Fokker–Planck equation in the working variables. The effect of the deviations in the electron flux in a state of thermodynamic equilibrium on the kinetic process was investigated. The dependence of the damping rate and the stable values of the angular and energy scattering on the velocity distribution of the electrons and the space heterogeneity of the electron beam in the radial direction was investigated qualitatively. Author (NSA)

N70-42313# Georgia Univ., Athens. Dept. of Chemistry.
DENSITY MATRIX APPROACH TO ATOMIC STRUCTURE Interim Scientific Report
Darwin W. Smith 29 Jun. 1970 6 p refs
(Grant AF-AFOSR-1655-69)
(AD-709984; AFOSR-70-1785TR) Avail: NTIS CSCL 7/4

The report is a very brief survey of progress made during the past year on the analysis of atomic wavefunctions by density matrix methods. A study was made of the advantages and disadvantages of various schemes of partitioning the 2-matrix into two parts, an uncorrelated reference term and a correlation correction. Author (TAB)

N70-42315# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
DIFFICULTY AND POSSIBILITY OF KINETIC THEORY OF QUANTUM-MECHANICAL SYSTEMS. PART 2: THE QUANTUM-MECHANICAL LIOUVILLE EQUATION AND ITS SOLUTIONS
Toyoki Koga May 1970 30 p refs
(Contract Nonr-893(38); DAHC04-69-C-0077; ARPA Order 529; ARPA Order 1442)
(AD-709990; PIBAL-70-28) Avail: NTIS CSCL 20/10

The theme of this report is a problem of correlation, as is illustrated in section 1 by considering the two-electron problem according to the Schrodinger equation. In section 2, the Schrodinger equation is reduced to a partial differential equation which is equivalent to the classical Liouville equation, to the approximation of nullifying h squared in the former. Author (TAB)

N70-42317 Michigan Univ., Ann Arbor.
SIX AND SEVEN PARTICLE FINAL STATES IN PION-DEUTERON INTERACTIONS AT 3.65 BeV/c
Anthony Rankin Fisher (Ph.D. Thesis) 1969 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 18000

An analysis is presented of the meson and isobar states of reactions: (1) positive pion, deuteron yields proton, proton sub s, two positive pions, two negative pions, and (2) positive pion, deuteron yields proton, proton sub s, two positive pions, two negative pions, neutral pion. The data were gathered by studying 250,000 pictures of positive pion deuteron interactions in the 20-inch bubble chamber at an incident momentum of 3.65 BeV/c. Reaction (1) is dominated by neutral rho meson and N*(1238) resonances, while reaction (2) contains a considerable amount of the omega and N* (1238) resonances. Also contained in reaction (2) are enhancements in the five pion system (three positive pions, two negative pions, neutral pion) which appear in the eta prime (958) meson, A2(1300), are R(1700) regions. Attempts were made to determine the spin-parity of the enhancement in the A2(1300) region, and to resolve the structure of the enhancement within the R(1700) region. A comparison is made between reaction (1) and its equivalent charge-symmetric reaction (3) negative pion, proton yields neutron, two positive pions, two negative pions concerning resonance production and cross sections. The degree of participation of the spectator proton (ps) in reactions (1) and (2) is discussed by comparing the results with the Impulse model and Hulthen theory. Also, the effects of Glauber screening and Pauli Exclusion are discussed. Dissert. Abstr.

N70-42329 Rice Univ., Houston, Tex.
ELECTRON SPIN POLARIZATION IN OPTICALLY PUMPED He 4
Michael Vance McCusker (Ph.D. Thesis) 1969 130 p ref
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 19316

Optical pumping was shown to produce substantial spin polarization in the 8 S sub 1 metastable atoms present in a weak helium discharge. By measuring the polarization of the free electrons extracted from such a discharge, the relative importance of the 8 S sub 1 state in ionization processes can be determined. The existing knowledge of ionization producing reactions in radio frequency helium discharges for the pressure range 0.05 to 1.0 torr is reviewed. The rate equations which describe the optical pumping process are presented. Using measurements of the resonance radiation absorbed during the pumping process, the population distribution of the pumped 8 S sub 1 atoms is computed. By assuming spin conservation, all cumulative ionization reactions involving the 8 S sub 1 atoms are shown to yield polarized electrons and the predicted electron polarization is also computed. Dissert. Abstr.

N70-42372*# Pittsburgh Univ. Pa. Dept. of Chemistry.
KINETICS AND MECHANISM OF NO2 FLUORESCENCE
L. F. Keyser, S. Z. Levine, and F. Kaufman 4 Aug. 1970 35 p refs

(Grants NGL-39-001-002; DA-31-124-ARO(D)-440)
(NASA-CR-114243; SRCC-134) Avail: NTIS CSCL 07D

Nitrogen dioxide fluorescence experiments with steady or modulated (8 and 20 kHz), monochromatic excitation at 4000 to 6000A and monochromatic observation have shown the process to be interpretable in terms of a single electronically excited state, undergoing vibrational relaxation at a gas-kinetic rate and electronic quenching about 100 times more slowly. An apparent radiative lifetime of about 55 microseconds was found, independent of excitation frequency, but the possibility of mixing with a vibrationally excited ground state makes this an upper limit to the lifetime of the hypothetical unperturbed 2B1 state. The average amount of vibrational energy transferred per collision was found to be 1000 + or − 500/cm based on a simplified stepladder model for the relaxation. Author

N70-42382 Princeton Univ., N.J.
THE REPRESENTATIONS OF THE SPECIAL CONFORMAL GROUP IN HIGH ENERGY PHYSICS
Albert Howard Clark, Jr. (Ph.D. Thesis) 1969 216 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 69-18156

Some general properties of the representations of the conformal group are established, including a result that indicates that the six mass-energy ranges which are distinguished in Special Relativity are invariant with respect to all conformal transformations. The real and zero mass representations of the conformal group are then found by using infinitesimal methods which start from the decomposition into irreducible representations of the scale group. Dissert. Abstr.

N70-42392 California Univ., Davis.
MONTE CARLO EVALUATION OF FEYNMAN PATH INTEGRALS IN IMAGINARY TIME
Suresh Vencatesh Lawande (Ph.D. Thesis) 1969 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-19637

A numerical method of evaluating the many dimensional Feynman path integrals in imaginary time is proposed. This method, which involves an importance sampling Monte Carlo integration scheme, is described in detail taking a one-dimensional harmonic oscillator as a test example. Applications of the method to obtain the ground state wave functions and energies of some simple quantum systems are presented. The path integrals in some curvilinear coordinates are developed. In particular, path integrals in spherical polar coordinates are used to obtain the ground state wave functions and energies of some quantum systems with spherically symmetric potentials of solvable types. The special cases of the isotropic oscillator and the attractive Coulomb potential are discussed. A brief description of the modifications necessary to take into account the effects due to quantum statistics is given along with some numerical results. Dissert. Abstr.

N70-42417 Rice Univ., Houston, Tex.
A MODEL FOR BEAM FOIL EXCITATION OF HE(+)
Robert Eugene Yager (Ph.D. Thesis) 1969 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-19342

The distribution of excited states in a high energy He(+) beam passing through a thin carbon foil was studied both experimentally and theoretically. The experiments were designed to determine the relative populations of the orbital angular momentum states in the n = 5 level and the total population of the n = 5 level in He(+) as a function of incident ion energy. Predictions are made of these populations using a free atom model of the carbon foil. Direct excitation of He(+) from the ground state, deexcitation of excited states of He(+), transitions among states in the n = 5 level, and capture of an electron from carbon by He(++) into an excited state of He(+) are considered and cross sections are calculated in the Born approximation for these processes. The rate equations are evaluated to obtain the predicted populations for comparison with experiments. Dissert. Abstr.

N70-42419 Michigan Univ., Ann Arbor.
STRUCTURE OF ELECTRON BUBBLES IN LIQUID HELIUM FROM PHOTO-EJECTION UNDER PRESSURE
Christie Lewis Zipfel (Ph.D. Thesis) 1969 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-18142

A critical experimental test of the bubble model of excess electrons in liquid helium is presented. In the bubble model an electron is self-trapped in a spherical cavity which appears to the electron as a spherical square well potential. If the model is correct, it should be possible to eject an electron from the bubble with a photon of the appropriate energy. This photoejection effect is detected by observing changes in the mobility of negative charge carriers drifting in an electric field when light in the near infrared is focussed in the drift region. The cross section for this effect was measured at pressures from 10.5 to 249 psi. The experimental cross sections were compared with the theoretical cross sections for photoejection of an electron from a spherical square well of given radius and well depth. It is possible by comparison with the simple theory to assign a radius and well depth to the bubble at each pressure studied. The values of the radius and well depth are compared with theoretical predictions and with other experimental measurements. Dissert. Abstr.

N70-42432 Rice Univ., Houston, Tex.
PRODUCTION, ACCELERATION, AND UTILIZATION OF POLARIZED HELIUM THREE IONS
David Owen Findley (Ph.D. Thesis) 1969 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-19287

A source of polarized He(+)-3 ions has been constructed. An optical pumping technique is used to polarize the nuclear spins of the ions, which are extracted in the manner of an RF ion source of conventional design. A description of the optical pumping process in a flowing gas system is given, and the influence of the requirements of this process on the design of the ion source are discussed. The components of the ion source are described. In a nuclear double scattering experiment, a polarization of 0.05 was observed in the ion beam, with an intensity of 4 microamperes. Dissert. Abstr.

N70-42447# Utrecht State Univ. (Netherlands). Inst. of Theoretical Physics.
THREE-NUCLEON CALCULATIONS USING THE FADDEEV EQUATIONS
Rudi Malfliet (Ph.D. Thesis) Apr. 1970 99 p refs Sponsored by Neth. Organ. for Pure Sci. Res.
Avail: NTIS

The Faddeev three-body problem formulation was used to study the interaction of three nucleons. As the Faddeev equations give rise to severe numerical problems an iterative method of solving them is critically discussed and the results are compared with those obtained by other methods. A study of the off-shell effects on three-body observables together with an investigation of the sensitivity of these three-particle observables on certain two-particle data are also discussed. ESRO

N70-42469 Rice Univ., Houston, Tex.
FOCUSING POLAR MOLECULES IN A HEXAPOLE ELECTRIC FIELD
Eugene Madison Jones (Ph.D. Thesis) 1969 164 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-19306

The construction, as well as the operation, of a hexapole electric field for focusing polar molecules is presented. Exact

calculations involving a trajectory analysis of symmetric top molecules through the hexapole field are discussed. A comparison of calculated and experimental transmissions for several symmetric top molecules [CH3I, CF3I, CCl3H, and (CH3)3CI] is shown to be very good. It is shown that the calculated and experimental transmissions may be used to determine dipole moments for the molecules. The transmission calculations and experimental work were extended to investigate the behavior in the hexapole field of both asymmetric top molecules and molecules with internal rotation. Molecules studied include CH2O, CH2Cl2, and CH3NO2. A discussion is given showing that the dipole moment and structure of a molecule may be approximated using the transmission of the molecule in the hexapole electric field. Dissert. Abstr.

N70-42471 Miami Univ., Fla.
A NONRELATIVISTIC MODEL OF N-FERMION BOUND STATES
Peter Leslie Wimmer (Ph.D. Thesis) 1969 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-17936

A nonrelativistic model of N-fermion bound states is proposed. It is concerned with the relative motion of the subparticles, and the intrinsic spins of the fermions; dependence on center of mass and internal (l-spin, hypercharge, etc.) variables are separated out. Eigenvalue equations for total angular momentum, parity, and mass are written down, with the requirement of invariance under the Bom reciprocity principle applied to the relative coordinates and momenta. Ladder operators connecting different states are derived, and are used to construct all solutions from a ground state. The solutions for 3-fermion bound states are applied to baryonic resonances, yielding mass formulae for N, Y sub 0, and Y sub 1 resonances. Dissert. Abstr.

N70-42488 Pittsburgh Univ., Pa.
ANALYSIS OF CONVERSION ELECTRONS FROM THE (p,2n) AND (p,n) REACTION ON MEDIUM AND HEAVY NUCLEI
Leonard Hillel Goldman (Ph.D. Thesis) 1969 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-17810

Internal conversion electrons following (p,n) and (p,2n) reactions were studied with a six gap orange type beta ray spectrometer. Three previously unreported E0 transitions are found in Hg-198, Pb-204, and Po-208 via the (p,2n) reactions on Au-197, Tl-205, and Bi-209 respectively. New levels with spin-parities are reported for Au-195 which was studied by conversion electrons from the Pt-196 (p,2n)Au-195 reaction and the observation of tritons from the Au-197(p,t)Au-195 reaction. The results from the (p,n) and (p,2n) reaction on In-113 and In-115 are presented and the location of the 6(+) level in Sn-114 is reported. In addition to the experimental results, the utility of the spectrometer in nuclear structure work is discussed. Surveys for millisecond and microsecond isomers and nuclear structure studies with (d,p) reactions are appended. Dissert. Abstr.

N70-42510# Oak Ridge National Lab., Tenn. Neutron Physics Div.
STATUS OF NEUTRON TRANSPORT IN THE ATMOSPHERE
E. A. Straker 29 Jul. 1970 28 p refs
(AD-710267; ORNL-TM-3065) Avail: NTIS CSCL 20/8

Attempts have been made since the mid 1940's at determining the radiation fields from nuclear weapons. Earlier attempts were experimental in nature with the efforts in the first few years being mostly calculational. A review of the progress that has been made in the past few years, the information that is currently available, and approaches to solving the problem of determining the detailed radiation field description is given. Author (TAB)

N70-42552# Aerospace Corp., El Segundo, Calif. Lab. Operations.
COMPARISON OF NEAR AND FAR INFRARED SPECTRAL DATA FOR THE WATER MOLECULE
Jerome M. Dowling 26 Aug. 1970 22 p refs
(Contract F04701-70-C-0059)
(AD-710805; TR-0059(9260-01)-7; SAMSO-TR-70-280) Avail: NTIS CSCL 7/4

Differences of the pure rotational energy levels of the water molecule obtained from high resolution near infrared data (i.e., the combination relations) are compared with appropriate sums or differences of pure rotational transitions obtained from high resolution far infrared data. The comparison indicates no inconsistency between the near and far infrared data. A sample calculation by least squares method demonstrates that significant improvements in the determination of the pure rotational energy levels of the water molecule are possible. Author (TAB)

N70-42569 National Lending Library for Science and Technology, Boston Spa (England).
HIGH-ENERGY GAMMA RADIATION FROM Ir 192
L. Schellenberg et al 8 Jun. 1970 9 p refs Transl. into ENGLISH from Helv. Phys. Acta (Basel), v. 40, no. 5, 1967 p 639–644
(NLL-LB/G/2895-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The higher energy gamma spectrum resulting from the decay of Ir-192 was studied with lithium drifted germanium detectors. Gamma ray energies and intensities are given for the transitions above 800 keV and for some prominent lines at lower energy. Author

N70-42571*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
PERTURBATION THEORIES OF WEAK INTERMOLECULAR FORCES
Phillip Robinson Certain (Ph.D. Thesis) 1969 155 p refs
(Grant NGL-50-002-001)
(NASA-CR-114189; WIS-TCI-347) Avail: NTIS CSCL 20H

A contribution is made to the development of a workable exchange perturbation theory for intermolecular forces. The first part develops a perturbation formalism for degenerate and almost degenerate energy states. The formalism is related to other methods and can have a greater range of validity than the Rayleigh–Schroedinger perturbation theory. The second part extends the formalism to exchange problems and leads to the Hirschfelder–Silbey perturbation theory. A method of solving the first order equation is developed which reduces the many electron equation to one and two electron equations. The third part applies four different perturbation formalisms for exchange forces to three model problems: the hydrogen molecule at internuclear separations R = 4, 6, 8 a sub 0; a harmonic oscillator model of the hydrogen molecule ion; and the delta-function model of the hydrogen molecule ion. Author

N70-42582# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
THE INTERACTION OF HEAVY keV IONS WITH GASES Progress Summary Report
John W. Boring Jun. 1970 29 p refs
(Contract AT(40-1)-2911)
(AEEP-3930-107-70U; ORO-2911-12) Avail: NTIS

Differential scattering cross sections for light ions colliding with rare gases and measurement of the total ionization by keV ions in argon mixtures are reported. Some preliminary results for scattering of protons by argon and krypton at 2 to 5 keV are included. Theoretical work on stopping cross sections and on calculation of differential inelastic scattering cross sections is also outlined. Some results showing the value of the nuclear stopping cross section for protons in Ar obtained using different interaction potentials are given. NSA

N70-42589 National Lending Library for Science and Technology, Boston Spa (England).
ON THE DETERMINATION OF THE SPECTRUM OF SLOWING-DOWN NEUTRONS IN A COLLIMATED BEAM BY THE METHOD OF BORON FILTERS
L. Aleksanarov et al 24 Feb. 1970 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Bulgare Sci. (Sofia), v. 2, no. 3, 1968 p 195–198
(NLL-WH-Trans-281-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Eng.: 1 NLL photocopy coupon

An algorithm is presented which overcomes the mathematical difficulties associated with the use of boron filters in neutron attenuation spectroscopy. It is felt that the difficulties arose because the problem was assumed to be well-posed. Therefore the new algorithm was developed considering the problem to be ill-posed, making the solution possible. N.E.N.

N70-42598# California Univ., Berkeley. Lawrence Radiation Lab.
PHYSICS Semiannual Report, May–Oct. 1969
Dec. 1969 126 p refs
(UCRL-19415) Avail: NTIS

A summary of research at the Lawrence Radiation Laboratory during the period from May to October 1969 is presented. This research is theoretical and experimental and covers high-energy physics primarily, although some atomic and plasma physics is also studied. Computing and data handling and accelerator operation and development are also covered. Lists of publications and papers are included. NSA

N70-42599# Washington Univ., Seattle. Dept. of Physics.
PERTURBATION THEORY AND SELF MASS INSERTIONS
Lowell S. Brown [1969] 24 p refs
(Contract AT(45-1)-1388)
(RLO-1388-564) Avail: NTIS

First order perturbation corrections to strong interaction amplitudes are considered in the context of quantum field theory. It is shown that such corrections may be expressed entirely in terms of on-mass-shell matrix elements of the unperturbed system, matrix elements which are evaluated at the unperturbed mass. The general method is illustrated by a detailed discussion of form factor corrections. In particular, the method is applied to the conserved vector form factor of a meson multiplet, and it is shown that the Ademollo–Gatto theorem holds only if the perturbation is local. The violation of this theorem which occurs in the electro-magnetic correction to pion beta-decay is discussed. Author (NSA)

N70-42612 Princeton Univ., N.J.
ON THE EXISTENCE OF THE COVARIANT T-PRODUCT OF CURRENTS AND ON THE FIXED J-POLES IN PHOTOPRODUCTION PROCESSES
Shun-Yi Lee (Ph.D. Thesis) 1969 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-18172

The existence of the covariant T-product for any number of currents is studied without introducing the extraneous assumption that the currents have any connection with a gauge principle. The result is that there always exists a covariant T-product for any number of currents, which can be constructed explicitly by an algebraic method. The divergences of this covariant T-product are those which would be obtained from an ordinary T-product if Schwinger terms were consistently ignored. The fixed poles are discussed in the photoproduction process. An argument, based on a potential theory model, claims that fixed poles are absent in the photoproduction process if the external particles lie on Regge trajectories. It is also pointed out that high energy, backward pion photoproduction is the best place to look for right signature fixed poles in the complex J-plane. Dissert. Abstr.

N70-42615# Addis Translations International, Woodside, Calif.
CALCULATION OF THE BAND STRUCTURE OF ScC AND ScN [BERECHNUNG DER BANDSTRUKTUR VON SCC UND SCN]
K. Schwarz et al Jun. 1970 26 p refs Transl. into ENGLISH from Theor. Chim. Acta (West Ger.), v. 15, 1969 p 149–164 Prepared for Sandia Corp.
(SC-T-70-4024) Avail: NTIS

The energy band structures of ScC and ScN were calculated by the augmented-plane-wave (APW)-method. By using the atomic potentials of Herman and Skillman, the energy eigenvalues for 258 k points in the Brillouin zone were obtained. From these data the density of states and the Fermi energy were derived. The charge distribution within the atomic spheres in the crystal and within the atomic spheres of the free atoms are compared. The eigenfunctions make it possible to calculate the nl-character density, a quantity analogous to the state density. Author (NSA)

N70-42617# Washington Univ., Seattle. Dept. of Physics.
DEEP INELASTIC ELECTROPRODUCTION AND CONFORMAL SYMMETRY
David G. Boulware, Lowell S. Brown, and R. D. Peccei [1969] 28 p refs
(Contract AT(45-1)-1388)
(RLO-1388-577) Avail: NTIS

Motivated by the observed scale invariance of high energy inelastic electron-proton scattering, the constraints on a Compton amplitude that follow if it is invariant under the full group of conformal coordinate transformations are studied. Although the conformal group contains operations that interchange space-like and time-like coordinate intervals, a large class of manifestly causal amplitudes can be constructed. It is found that the strict application of conformal symmetry reduces the number of independent covariants from four to two in the case of a spin zero target. The two covariants of the conformal Compton amplitude remain independent when it is restricted to forward scattering. Hence invariance under the full conformal group yields no constraints on the structure functions of inelastic electron scattering other than that already provided by simple dilation invariance. Author (NSA)

N70-42618# Oak Ridge National Lab., Tenn.
MULTIPLY CHARGED HEAVY IONS PRODUCED IN A HOT ELECTRON PLASMA
I. Alexeff, W. D. Jones, and R. V. Neidigh 30 Apr. 1970 20 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2981) Avail: NTIS

Multiply charge argon-ion beams of sufficient intensity to be of interest as sources for heavy-ion accelerators were produced using the ORNL Mode 2 hot-electron plasma. Quantitative analysis of the first five charge states suggests that the dominant generation mechanism is the single-impact ionization process for which yields have recently been estimated by Postma. Author (NSA)

N70-42627# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
ACAUSAL DISPERSION RELATION AND S-WAVE PION-NUCLEON SCATTERING LENGTHS
Matsuo Sekine Aug. 1970 11 p refs
(RIFP-107) Avail: NTIS

The value of S-wave pion-nucleon scattering lengths was calculated using acausal dispersion relations. Under the assumption that causality is violated in the regions at distance, 0.6 of a meson Compton wavelength, the best fit a sub 1 + 2a sub 3 = −0.007/microns is obtained by analyzing recent experiments. The results are compatible with the phase shift analysis of Hamilton and Woolcock, that is, a1+2a3 = (−0.005 + or − 0.013)/microns. If causality holds, a1+2a3 = −0.104/microns is obtained. A non-local modification of the theory is presented. Author

N70-42659# Washington Univ., Seattle. Dept. of Physics.
FORMAL MULTIPERIPHERAL INTEGRAL EQUATION BASED ON THE VENEZIANO MODEL
R. D. Peccei [1969] 7 p refs Sponsored in part by AEC
(RLO-1388-574) Avail: NTIS

An operator multiperipheral integral equation based on the full n-point Veneziano model is derived. This operator equation can be transformed into a c-number integral equation, involving an infinity of hanging variables, whose form is similar to the equations obtained by Bardacki and Ruegg for the truncated Veneziano model. Author (NSA)

N70-42669# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
BROKEN CHIRAL SYMMETRY AND CORRECTIONS TO SOFT PION THEOREMS
V. S. Mathur and S. Okubo 19 Jun. 1970 12 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, USSR, Aug. 1970
(Contract AT(30-1)-875)
(UR-875-310; CONF-700806-6) Avail: NTIS

On the basis of the model of Gell-Mann, Oakes and Renner, it has been found that the points a = −1, 0, and 2 correspond to the exact validities of the SW(2), ordinary and chimeral SU(3) subgroups, respectively where a is the symmetry breaking parameter of the theory. Noting that at a = −1 and 2, the pion and kaon respectively become zero mass particles, on the basis of a smoothness assumption a simple way of evaluating corrections to the soft pion results is proposed. Especially, application to K-13, non-leptonic decays, and the Goldberger-Treiman relation are discussed. Author (NSA)

N70-42670# Notre Dame Univ., Ind. Radiation Lab.
PROCEEDINGS OF THE SYMPOSIUM ON VERY EARLY EFFECTS
W. Phillip Helman, Asokendu Mozumder, and Alberta Ross, eds. May 1970 256 p refs Proc. of Intern. Meeting on Primary Radiation Effects on Chem. and Biol., Buenos Aires, 9-14 Mar. 1970
(Contract AT(11-1)-38)
(COO-38-738; CONF-700319) Avail: NTIS

A record of the conversation concerning Very Early Processes in Radiation Chemistry and Radiation Biology to examine attainments, position and ignorance, and to consider the future and what answers and questions will emerge is presented. The topics discussed include: introduction of problems to be considered; the nature and behavior of excess electrons; electric field dependence of mobilities; thermalization and localization of electrons; thermalization models; dielectric relaxation; superexcited states and ionization; events in the solid state, earliest events in water; earliest effects observed in water; biological implications of early time events; nomenclature of electrons; and the nature of solvated electrons. NSA

N70-42673# Naval Postgraduate School, Monterey, Calif.
CALCULATION OF ELECTRON SCATTERING CROSS SECTIONS FOR CARBON-TWELVE AND LITHIUM-SIX USING PHASE SHIFT ANALYSIS
Samuel Johnson Dennis (M.S. Thesis) Jun. 1970 56 p refs
(AD-710353) Avail: NTIS CSCL 20/8

A phase shift analysis is used to obtain scattering cross sections for incident electrons on Carbon-12 and Lithium-6. Results are given for incident electron energies of 10 - 100 Mev and for scattering angles of 45, 90 and 135 degrees. A gaussian p-shell charge distribution is used for Carbon-12, and an empirical charge distribution developed by L. R. Suelzle is used for Lithium-6. A comparison is also made between the phase-shift results and results obtained using the Born approximation. Author (TAB)

N70-42674# Naval Postgraduate School, Monterey, Calif.
COLLISIONAL DE-EXCITATION RATES FOR THE FIRST NEGATIVE AND SECOND POSITIVE SYSTEMS OF NITROGEN
Ronald Francis Walters (M.S. Thesis) Jun. 1970 33 p refs
(AD-710355) Avail: NTIS CSCL 7/4

Nitrogen and nitrogen-carbon dioxide gas mixtures were excited by 1.5 MeV protons from a Van De Graaff generator. Intensity versus pressure data were recorded and plotted for the first negative (lamda = 3914.4A) and for the second positive (lamda = 3371.3A) transitions of molecular nitrogen. With the use of theoretical equations and the experimental data the reaction rates, k, and collisional de-excitation cross sections were calculated. Author (TAB)

N70-42675# California Univ., Berkeley. Lawrence Radiation Lab.
ATOMIC BEAM MEASUREMENT OF THE 39-41-42 K ISOTOPE SHIFT
Richard Marrus, Edmond C. Wang, and Joseph Yellin Dec. 1969 17 p refs
(Contract W-7405-eng-48)
(UCRL-19520) Avail: NTIS

The isotpe shifts of (K-41) and 12.4 hour (K-42) relative to (K-39) were studied in the D sub 1 line by the atomic beam method and found to be +7.4 + or − 0.3 and +16 + or − 4, respectively, in units of 0.001 cm sup 0.1. Author (NSA)

N70-42683# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
CONVOLUTION ANALYSIS OF ELECTRON IMPACT EXPERIMENTS
Ronald L. Cowperthwaite and Howard Myers 1 Jul. 1970 43 p refs
(Contract F19628-70-C-0134)
(AD-710407; SCIENTIFIC-1; AFCRL-70-0379) Avail: NTIS CSCL 20/8

Electron impact experiments are analyzed from the standpoint of the influence of the electron beam energy distribution on the measurements. A generalized electron energy distribution function is formulated. Special cases of this distribution function yield analytical representations of operational electron guns. The energy distribution of the gun is found to strongly affect the salient features of the cross section. A procedure is thence developed for unfolding the true cross section from impact measurements by removing the distortion of the electron beam. Comparisons with measured data are presented. The response function for a simple retarded gun is derived. The unfolding equation is found to be a first order differential equation. This is in strong contrast to the simple accelerated electron gun which gives an algebraic equation for the unfolding equation. The stability of the integration, with respect to errors in the initial value, is evaluated. The solution is found to be exponentially unstable when forward integration is used, and exponentially stable when backward integration is used. An important practical consequence of the backward integration stability is that it permits estimating the initial value of the true cross section with the folded cross section. Author (TAB)

N70-42690 Michigan Univ., Ann Arbor.
PION DEUTERON ELASTIC SCATTERING AND BREAK UP AT 3.65
Hsien-chih Hsiung (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-18028

The differential cross section for the elastic scattering of positive pions from deuterons at 3.65 BeV/c was measured. Measurements were made for −t, the four momentum transfer squared, in the range 0.043-1.0 (BeV/c)sq. The data were obtained in a 222,000 picture exposure of the 20-inch deuteron bubble chamber. Experimental results are compared with calculations basec

on the Glauber high-energy approximation, utilizing the total 3S1 + 3D1 dusteron wave function and pion-nucleon scattering amplitudes. The experimental data do not show evidence for a pronounced dip. The differential cross section for the deuteron break up reaction positive pion + deuteron yields positive pion + proton + neutron, at 3.65 BeV/c was also measured for −t in the range 0.0625-0.30 (BeV/c) sq. A theoretical prediction, based on Glauber's approximation, was calculated for a particular final state, E sub p = E sub n, and compared with the experimental results. Dissert. Abstr.

N70-42700 California Univ., Berkeley.
EVALUATION OF THE FIELD ISOTOPE EFFECT FOR THE LIGHT ELEMENT CALCIUM
Gabriel Leo Epstein (Ph.D. Thesis) 1969 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-18912

Optical isotope shifts of the even-even calcium isotopes are measured in the Cal 4227 A spectrum line. Use of a piezoelectric scanning Fabry–Perot interferometer and the recording of light from each isotope separately allows the measurement of shifts less than the line width. An attempt is made to separate the mass and volume shifts solely from optical shift measurements. Separation is accomplished by use of electron scattering and mu-mesic X-ray data. The volume shifts give a picture of the variation of the calcium charge radius in agreement with that derived from electron scattering experiments. Dissert. Abstr.

N70-42716# National Accelerator Lab., Batavia, Ill.
UPPER LIMIT FOR MAGNETIC MONOPOLE PRODUCTION BY NEUTRINOS
R. A. Carrigan, Jr. and F. A. Nezrick Jun. 1970 13 p refs Sponsored by AEC
(NAL-44) Avail: NTIS

Existing magnetic monopole searches are reevaluated in terms of monopole production by cosmic ray neutrinos. The upper limit for the cross section for monopole production inside the best Ocean bed sample is sigma sub D < or = to 1.0 × 10 to the minus 39th power E sup 2 sub T sq cm. An even lower limit of sigma sub C < or = to 3.0 × 10 to the minus 45th power E sup 2 sub T sq cm is established if the monopoles are collected on the sample from surrounding ocean water. Author (NSA)

N70-42717*# Oak Ridge National Lab., Tenn. Neutron Physics Div.
THE ABSORBED DOSE AND DOSE EQUIVALENT FROM NEGATIVELY AND POSITIVELY CHARGED PIONS IN THE ENERGY RANGE 10 TO 2000 MeV
R. G. Alsmiller, Jr., T. W. Armstrong, and Barbara L. Bishop 24 Aug. 1970 53 p refs Submitted for publication
(NASA Order H-38280A)
(NASA-CR-110876; ORNL-TM-3105) Avail: NTIS CSCL 20H

Nucleon-meson cascade calculations were carried out for broad beams of monoenergetic negatively and positively charged pions normally incident on a semi-infinite slab of tissue 30-cm thick, and the absorbed doses and dose equivalents as a function of depth in the tissue are presented. Results are given for incident energies of 10, 30, 84, 150, 500, 1000, and 2000 MeV. For the lower incident energies (< or = to 84 MeV), the pion range is < 30 cm in tissue, and peaks in the absorbed doses and dose equivalents, due to the reaction products produced by the nuclear capture of the stopped negatively charged pions and to the decay products of the stopped positively charged pions, are clearly evident. Author

N70-42723# Chicago Univ., Ill. Dept. of Physics.
CROSSING REGGE TRAJECTORIES AND POLE-CUT RELATIONSHIPS
Reinhard Oehme Apr. 1970 24 p refs
(Contract AT(11-1)-264)
(EFI-70-23; COO-264-545) Avail: NTIS

The general features of typical pole-cut relations with crossing Regge pole trajectories are considered. The possible shapes of the resulting physical pole trajectories are described. Author (NSA)

N70-42724# Stanford Linear Accelerator Center, Calif.
A SYSTEMATIC PROCEDURE FOR DESIGNING HIGH RESOLVING POWER BEAM TRANSPORT SYSTEMS OR CHARGED PARTICLE SPECTROMETERS
Karl L. Brown Jun. 1970 15 p refs Presented at 3d Intern. Conf. on Magnet Technol., Hamburg, May 1970 Supported by AEC
(SLAC-PUB-762; CONF-700503-3) Avail: NTIS

By extrapolating the systematics of the general first- and second-order theory of beam transport optics to include higher order multipole terms, it has been possible to evolve a simple, step by step, procedure for the design of high resolving power static-magnetic beam transport systems. The choice of the appropriate dipole and quadrupole elements for a given system may be determined once the resolving power, solid angle, momentum range and detector system of the instrument have been specified. The partial derivative of any nth-order aberration coefficient with respect to an nth-order multipole component located anywhere in the system has been derived. From this coupling coefficient, the strength and the optimum location of multipole element(s) to correct or modify a given aberration or group of aberrations is uniquely determined. Author (NSA)

N70-42725# Purdue Univ., Lafayette, Ind. Dept. of Physics.
ON PARTICLE PHYSICS Annual Progress Report, 1 Jun. 1969 –31 May 1970
F. J. Loeffler 31 May 1970 23 p refs
(Contract AT(11-1)-1428)
(COO-1428-203) Avail: NTIS

The research accomplished during the period is briefly summarized. Various particle interactions analyzed using the bubble chamber are discussed. The measuring-computing system is described, also. A list of publications is given. NSA

N70-42729# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
THE THEORY OF Li-7 ION SCATTERING IN RARE GASES [ZUR THEORIE DER STREUUNG VON Li-7-IONEN AN EDELGASEN]
Heinz Schoenebeck (Ph.D. Thesis) 1968 102 p refs In GERMAN
Avail: NTIS

The scattering of single positively charged Li-7 ions at acceleration energies between 7 and 60 kV in single atomic gases is investigated theoretically. The experiments are designed to indicate the scattering intensity maxima at scattering angles from 0.0001 to 0.001 rad. In constrast, such maxima are not observed during electron scattering in rare gas atoms when the scattered electrons possess kinetic energy. The interaction potentials and scattering amplitudes are calculated. Integration of the total and differential cross sections is carried out and the theoretical results are compared with experiment. Transl. by R.B.

N70-42742# National Bureau of Standards, Washington, D. C.
PHONON TRANSPORT IN BARIUM TITANATE AND RUTILE
Alexander Johan Hendrik Mante (Ph.D. Thesis–Utrecht Univ.) Utrecht Univ. 1969 130 p refs Partly in DUTCH and partly in ENGLISH Sponsored by Neth. Organ. for Pure Sci. Res.
Avail: NTIS

Thermal conductivity measurements were made to investigate the phonon transport properties of barium titanates and rutile as the dips in the thermal conductivity/temperature curve should be related to small changes in the phonon spectrum. The thermal

conductivity of barium titanate below 30 K depends on the number of ferroelectric domains and intermediate walls scatter phonons due to the different domain orientations. The formation and disappearance of stacking faults in rutile were similarly investigated. ESRO

N70-42749# Pittsburgh Univ., Pa. Dept. of Physics.
CLASSICAL ELECTRODYNAMICS IN TWO DIMENSIONS: EXACT SOLUTION
I. Bialynicki-Birula May 1970 11 p refs
(Contract AT(30-1)-3829)
(NYO-3829-50) Avail: NTIS

Classical electrodynamics of N charged point-like particles, moving in the space-time of two dimensions is studied. The exact solution of this model is found and its properties connected with the Poincare group in two dimensions are described. In the case of N = 2, the solution reduces to a model of relativistic classical mechanics. Nonlinear generalizations of the model are also discussed. Author (NSA)

N70-42752 Princeton Univ., N.J.
MOLECULAR BEAM SCATTERING OF ARGON FROM THE (111) PLANE OF SILVER AT HYPERTHERMAL ENERGIES
Michael John Romney (Ph.D. Thesis) 1969 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-18184

The density distribution of argon scattered from the (111) plane of silver at 573 K was experimentally determined. A supersonic molecular beam apparatus employing seeded beam techniques was used to obtain incident argon energies from 0.064 to 4.35 eV. Throughout the energy range studied the scattering distributions can be described as a single lobe with the maximum lying in the general direction of the specular angle. The exact position of the maximum, the width of the distributions, and the maximum scattered signal vary with incident angle and energy. The general trends with incident angle and with incident energy are similar to those found by other investigators in the thermal energy range, however, above about 2 eV these trends reverse. As the energy is increased above 2 eV the scattering distributions move back toward the normal and become broader. The maximum scattered signal increases linearly with the incident beam energy. Dissert. Abstr.

N70-42762# Oslo Univ. (Norway). Inst. of Physics.
ROTATIONAL AND VIBRATIONAL STATES IN Er-171
I. Kanestroem [1970] 12 p refs
Avail: NTIS

A theoretical analysis of the energy levels of Er-171 to excitation energies of about 2.5 MeV was performed. A large number of previously observed states were assigned as specific Nilsson orbitals and their superimposed rotational bands. The energies, decoupling parameter and (d,p) cross sections suggest completely mixing between a gamma-vibrational state and the 1/2(-)(510) orbital. In Er-171 both the components of the 1/2(-)(510) states were identified. Author

N70-42763# Purdue Univ., Lafayette, Ind.
DOUBLE-REGGE-POLE-POLE ANALYSIS OF PION (+) PROTON YIELDS PION (+), RHO-MESON(0), PROTON AT 13.1 GeV/c
J. A. Gaidos, C. R. Ezell, J. W. Lamsa, and R. B. Willmann [1970] 33 p refs Presented at the 15th Intern. Conf. on High Energy Physics, Kiev, USSR
(COO-1428-218; CONF-700806-3) Avail: NTIS

A double-Regge-exchange analysis of the reaction positive pion + proton yields positive pion + neutral rho meson + proton at 13.1 GeV/c is presented. The events are divided into proton diffractive (approximately 80%) and pion diffractive approximately 20% categories, each of which requires two double-Regge amplitudes for a complete description. The data of each sample are well described by a double-Regge model consistent with duality. Author (NSA)

N70-42764# Washington Univ., Seattle.
UNITARY MODEL OF REGGE CUTS
Jan W. Dash, A. Pignotti, and J. R. Fulco (Calif. Univ., Santa Barbara) Oct. 1969 13 p refs
(RLO-1388-571) Avail: NTIS

A method of generating Regge cuts is proposed which is consistent with full connected unitarity. The results are applied to the recent Serpukhov pp data. Author (NSA)

N70-42765# Stanford Linear Accelerator Center, Calif.
NEW RESULTS ON HIGH-ENERGY ELECTROMAGNETIC INTERACTIONS
R. E. Taylor May 1970 29 p refs Presented at the Intern. Conf. on Expectations for Particle Reactions at the New Accelerators, Madison, Wis.
(SLAC-PUB-746; CONF-700314-3) Avail: NTIS

Summaries of research are presented for quantum electrodynamics, total photon–nucleon cross section, and electron scattering. NSA

N70-42776# State Univ. of New York, Stony Brook.
ISN'T IT TIME TO CALCULATE THE NUCLEON–NUCLEON FORCE?
G. E. Brown Jun. 1970 10 p refs
(NYO-4032-22) Avail: NTIS

The possibilities of calculating the nucleon–nucleon force considering one-boson-exchange models are discussed. This discussion covers the epsilon meson in pion-nucleon scattering, including repulsive contributions and pair suppression. It is concluded that the one-boson-exchange models are conceptually inadequate. NSA

N70-42782# Purdue Univ., Lafayette Ind.
DECAY PROPERTIES OF THE NEUTRAL D MESON
W. J. Miller, J. H. Campbell, S. Lichtman, F. J. Loeffler, D. H. Miller et al [1970] 8 p Presented at the 15th Intern. Conf. on High Energy Phys., Kiev Sponsored in part by AEC
(COO-1428-224; CONF-700806-19) Avail: NTIS

A maximum likelihood fit to the eta meson, pion, pion Dalitz plot using pion(+) d yields p (sub s) p pion(+) pion(-) eta-meson data at 2.7 and 3.1 GeV/c shows events in the D region concentrated in the center of the Dalitz plot. Author (NSA)

N70-42790# California Inst. of Tech., Pasadena.
BROKEN SCALE INVARIANCE AND SCALING LAWS IN ELEMENTARY PARTICLE PHYSICS
Curtis G. Callan, Jr. [1970] 16 p Presented at the Am. Phys. Soc., Washington, D.C.
(Contract AT(11-1)-68)
(CALT-68-259; CONF-700419-1) Avail: NTIS

In order to implement a previous suggestion that scale invariance might be useful as a broken symmetry, the method of scaling laws is described. This method provides a systematic way of extracting observable consequences from specific assumptions about the breaking of scale invariance. NSA

N70-42792# Purdue Univ., Lafayette, Ind. High Energy Physics Group.
PROPOSAL TO STUDY SINGLE MESON PRODUCTION IN MESON NUCLEON INTERACTIONS AT 50 AND 100 GeV/c
D. H. Miller and L. J. Gutay 10 Jun. 1970 29 p refs Sponsored in part by AEC
(COO-1428-210) Avail: NTIS

The general type of reaction meson + nucleon yields meson + meson + nucleon is studied. In particular, it is first proposed to analyze specific t channel proton-pion and proton kaon interactions yielding 3-particle combinations of neutrons, pions and kaons, with a spectrometer or hybrid spectrometer. The physics to be obtained would be: Study of high mass resonant states to obtain widths, positions, coupling constants, spin-parities and G parities; Study of the one pion exchange contribution for the above reactions at high energies; Study of the pion pion scattering amplitudes in the T = 2, 1 and 0 isospin states; Study of the diffractive single meson production process at the nucleon vertex and its interference with the one particle exchange single meson production process, and obtain information on the properties of the Pomeron trajectory (diffraction scattering) from the pion(+) pion(+), pion(+) p yields sigma(+) K(+) which have essentially the same requirements. Author (NSA)

N70-42803# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
Pu-239 DETECTION IN VIVO WITH A GERMANIUM LITHIUM ARRAY
William H. Tyree and Robert W. Bistline 12 Jun. 1970 8 p refs
(Contract AT(29-1)-1106)
(RFP-1488) Avail: NTIS

Results are given of simulated in vivo measurements of plutonium-239 amounts detected in the chest (lung) cavities of a water-filled phantom model. The device developed is a germanium-lithium detector array, using the 51.63 kiloelectron-volt gamma ray from plutonium-239. A minimum detectable three-sigma limit of about 4.5 maximum permissible lung burdens was obtained in 4000 seconds. The development of larger germanium-lithium detectors suggests a capability of measuring plutonium deposited in vivo in amounts less than one maximum permissible lung burden. Comparisons are included of some parameters of other detection systems for whole-body counting of low energy emissions (photons). Author (NSA)

N70-42807# Los Alamos Scientific Lab., N.Mex.
RELOADING METHOD OF PROTON INJECTION IN ACCELERATORS AND ACCUMULATORS
G. I. Dimov Dec. 1969 23 p refs Transl. into ENGLISH from the Russian
(LA-TR-70-5; IIF-304) Avail: NTIS

The theory of multi-turn proton injection in synchrotrons by the reloading method is described. Beams of H(0) or H(−) are injected into the proton orbit for the reloading injection of protons. Reloading processes, scattering on target nuclei, ionization losses of energy, and the capture coefficient are discussed. NSA

N70-42808# Scientific Translation Service, Ann Arbor, Mich.
INDUCED RADIOACTIVITY AT THE IHEP PROTON SYNCHROTRON
V. T. Golovachik et al [1969] 13 p refs Transl. into ENGLISH from the Russian Transl. for Oak Ridge Natl. Lab.
(ORNL-TR-2328; IHEP-69-76) Avail: NTIS

Graphs are presented for the induced radioactivity distribution along the accelerator, induced radioactivity buildup in the zone of the target station, and decay curves of induced radioactivity. Also, the gamma-spectrum of the vacuum chamber, contributions of identified isotopes to the dose of gamma rays, dose per unit of gamma flux as a function of cooling time, and isodose curves of induced radioactivity in the zone of the target station are presented diagrammatically. NSA

N70-42817# Stanford Linear Accelerator Center, Calif.
SLAC LARGE WIRE SPARK CHAMBER SPECTROMETER
D. W. G. S. Leith and G. J. Luste Jun. 1970 15 p refs Presented at the Exptl. Meson Spectry. Conf., Philadelphia, 1–2 May 1970 Sponsored by AEC
(SLAC-PUB-754; CONF-700525-1) Avail: NTIS

The development of a large wire spark chamber spectrometer for studying peripheral processes in the energy range of 5 to 20 GeV/c and particularly meson spectroscopy is described. The design of the system is described, and its performance for studying the negative pion + proton yields positive pion + negative pion + proton interaction at 16 GeV/c is given. NSA

N70-42823# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
A SEARCH FOR Q PRODUCTION IN CHARGE EXCHANGE REACTIONS
B. Werner, P. Slattery, and T. Ferbel 1 Jul. 1970 15 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev Sponsored in part by NSF
(Contract AT(30-1)-875)
(UR-875-312; CONF-700806-4) Avail: NTIS

The K pion pion enhancement at low mass (the Q effect) was observed in K(+ or −) N interactions only in the same charge state as the incident beam particle. The lack of observation of the Q in other charge states has been cited as evidence for the diffractive nature of Q production. The cross section for dissociation of the K meson coupled with charge exchange at the nucleon vertex is expected to be approximately 1/100 that for diffractive dissociation. In order to obtain sufficient statistics for the study of Q(++) and Q sup 0 production in K(+ or −) p yields nK sup 0 sub 1 pion (+ or −)pion(+) the K sup 0 pion (+ or −) pion(+) mass spectra observed in several experiments are combined. These data will be compared with the predictions of a multiperipheral model. Author (NSA)

N70-42836# Oslo Univ. (Norway). Inst. of Physics.
POSITIVE PARITY STATES IN Er 167
I. Kanestrom and G. Lovhoiden [1970] 17 p refs
Avail: NTIS

The positive parity states in Er-167 are described in terms of the rotational model, where the particle-rotation coupling is taken into account. The moment of inertia, the Fermi energy and the coupling strength are determined by fitting the energies. The wave functions thus obtained are used to calculate the (d,p) stripping and (d,t) pick-up cross sections and branching ratios. The results obtained are in agreement with experimental data. Author

N70-42837# Kansas Univ., Lawrence. Nuclear Physics Lab.
A TABLE OF EO CONVERSION PROBABILITY ELECTRONIC FACTORS
D. A. Bell, C. E. Aveledo, J. P. Davidson, and M. G. Davidson 30 Jan. 1970 55 p refs
(Contract AT(11-1)-1120)
(COO-1120-100) Avail: NTIS

The electronic factors of the electric monopole conversion probabilities as a function of the atomic charge number Z and transition energy k for K, L sub 1, and L sub 2 shells are presented in tabular form. The table lists factors over a range of k/mc squared from 0.1 to 5.0 units in increments of 0.1 units and from Z = 40 to 102 in steps of Delta Z = 2. The factors are calculated relativistically and include corrections for finite nuclear size and bound-state atomic screening. Author (NSA)

N70-42842# Purdue Univ., Lafayette, Ind.
DOUBLE-REGGE POLE ANALYSIS OF PION(+) PROTON YIELDS PION(+) PION (-) DELTA HYPERON (++) AT 13.1 GeV/c
J. A. Gaidos, C. R. Ezell, J. W. Lamsa, and R. B. Willmann [1970] 22 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev Submitted for publication Sponsored in part by AEC
(COO-1428-217; CONF-700806-2) Avail: NTIS

A double-Regge model is applied to the specified reaction. A good description of the data is given in terms of two amplitudes involving Pomeranchuk/pion and Pomeranchuk/delta hyperon exchanges. Author (NSA)

N70-42843# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Physics.
SEARCH FOR PROTON DECAY AS A TEST OF BARYON CONSERVATION
Frederick William Dix (Ph.D. Thesis) Jan. 1970 43 p refs
(Contract AT(11-1)-1749)
(COO-1749-12) Avail: NTIS

A large volume heavy water Cherenkov detector enclosed in a liquid scintillator anticoincidence shield was used to search for proton decay. The 550 gallons of D2O used were obtained on loan from the Savannah River Plant of the Atomic Energy Commission. The experimental site was located 1950 feet underground to reduce cosmic ray and other background. A lower limit on the proton lifetime of 3.1 × 10 to the 23rd power years was established, independent of the mode of decay. The results were also interpreted to set an upper limit on the B-8 solar neutrino flux of 950 million/sq cm-sec. Author (NSA)

N70-42846*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPANDED FORTRAN 4 PROGRAM FOR ELASTIC SCATTERING ANALYSES
Margaret M. Smith and Charles C. Giamati Washington Sep. 1970 110 p refs
(NASA-TN-D-6000; E-5607) Avail: NTIS CSCL 20H

The SCATLE program is a FORTRAN 4 nuclear optical model program which is a revision and extension of program SCAT4. Program SLATLE is described as a user's guide. The SCATLE program calculates elastic scattering cross sections, polarizations, phase shifts, and triple scattering values. An automatic search varies the nuclear parameters to improve agreement between calculated and experimental cross sections and polarizations. Several nuclear potential forms are available. Author

N70-42896# Princeton Univ., N.J. Elementary Particles Lab.
CP VIOLATION AND REGENERATED Ke(0)3 DECAY
Mark W. Strovink (Ph.D. Thesis) 23 Mar. 1970 112 p refs
(Contracts AT(30-1)-2137; N00014-67-A-0151-0001)
(PURC-2137-23; TR-6) Avail: NTIS

With a wire-spark-chamber spectrometer, about 287,000 K sub e3 decays downstream of a 9.125-inch Cu regenerator were reconstructed. The observed asymmetry between e(+) and e(−) events was normalized by a corresponding sample of free decay data. The regeneration phase in Cu at a mean momentum of 2.2 GeV/c is given. This value includes a correction for the effect of diffractive and inelastic regeneration. By a unique method, this correction largely was determined from the data itself. The relation between the observed amplitude of the K sub e3 asymmetry and the change in S equals change in Q selection rule also was examined. Author (NSA)

N70-42897# Stanford Linear Accelerator Center, Calif.
RESONANCE MIXING, DIPOLES AND ZOMBIES
Lee Stodolsky Jun. 1970 14 p refs Presented at the Exptl. Meson Spectry. Conf., Philadelphia, 1 – 2 May 1970
(SLAC-PUB-776; CONF-700525-3) Avail: NTIS

A simple formalism for treating the problems of resonance mixtures is reviewed. The mass matrix formalism, resonance production, nonorthogonality, and the dipole are covered. NSA

N70-42900# Naval Postgraduate School, Monterey, Calif.
ELASTIC ELECTRON SCATTERING MEASUREMENTS OF THE NEUTRON CHARGE FORM FACTOR AT VERY LOW MOMENTUM TRANSFERS
Jake W. Stewart, Jr. (Ph.D. Thesis) Jun. 1970 135 p refs
(AD-709922) Avail: NTIS CSCL 20/8

Measurements of the ratio of the neutron-proton electric form factors, G(E sub n)/G(E sub p), were made from elastic electron-deuteron scattering to a precision of approximately 1 to 2% for the range of momentum transfers, q squared of 0.10 < or = q squared < or = 0.8 F sup (-2), and for electron scattering angles of 45 degrees to 120 degrees. It was found that within experimental errors the slope as determined from the ratio, G(E sub n)/G(E sub p), agrees with the thermal neutron-electron interaction slope when relativistic corrections and proper deuteron wave functions are applied to the electron-deuteron scattering results. Author (TAB)

N70-42903# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab
THERMAL NEUTRON RADIOGRAPHY WITH THE PLUTONIUM RECYCLE CRITICAL FACILITY
J. L. Cason, K. S. Maiwald, and E. P. Lippincott Jun. 1970 28 p
(Contract AT(45-1)-1830)
(BNWL-1373) Avail: NTIS

The feasibility of using the PRCF (Plutonium Recycle Critical Facility) for thermal neutron radiography was demonstrated. Results included flux measurements and neutron radiographs with both direct and indirect techniques. The PRCF was modified on a temporary basis to provide an internal and external beam of neutrons. Experiments were performed under both conditions which proved the feasibility of producing high quality neutron radiographs of various samples and test pieces. Recommendations and conclusions regarding possible approaches for permanent modification of PRCF are presented. Author (NSA)

N70-42904# California Inst. of Tech., Pasadena. Gates and Crellin Labs. of Chemistry.
INTERACTION OF LOW-ENERGY ELECTRONS WITH MOLECULES
Aron Kuppermann [1970] 14 p refs Presented at the 4th Intern. Congr. of Radiation Res., Evian, France, 28 Jun. – 4 Jul. 1970
(CALT-767-P-4-61; Conf-700610-3) Avail: NTIS

Electronic excitation processes occurring when electrons collide with molecules at energies ranging from threshold to about 30 eV above threshold are reviewed. The discussion is divided into a section on processes at less than 1 eV above threshold, in which resonant processes are improtant, and a section on processes at more that 1 eV above threshold. Both experimental and theoretical techniques appropriate for each energy range are considered. NSA

N70-42905# Purdue Univ., Lafayette. Dept. of Physics.
VERY HIGH ENERGY PROTON INTERACTIONS: EXPLORATORY SURVEY IN A BUBBLE CHAMBER
8 Jun. 1970 13 p refs
(COO-1428-212) Avail: NTIS

A bubble chamber study is proposed for the general features of proton proton interactions in the 200 to 500 GeV energy range in as much detail as measuring accuracy permits, starting with charged particle multiplicities, transverse and longitudinal momentum distributions, and detailed measurements of particle systems originating from the target proton, and extending to an exploration of the possibility of doing some four-constraint or equivalent kinematic analyses of complete events. A scanning search for any new or exotic phenomena is an important part of this proposal. There are 100,000 pictures requested initially in a 2 meter or 14 foot hydrogen bubble chamber, with a 200 GeV or greater proton beam. Author (NSA)

N70-42911# Sandia Corp., Albuquerque, N.Mex. Radiation Effects Div.
TRANSIENT ANNEALING OF EFFECTS IN IRRADIATED SILICON DEVICES
B. L. Gregory and H. H. Sander Jul. 1970 60 p refs Sponsored in part by AEC
(SC-RR-70-397) Avail: NTIS

The annealing of radiation-produced defects in semiconductor devices is discussed briefly for Co-60 gamma-ray and 1-MeV electron damage, and in detail for fast-neutron damage. The effects on the reordering processes of varying the material parameters and the irradiation conditions are considered. Transient annealing of neutron damage near room temperature has been investigated for a wide variety of devices, and the data are presented in generalized form to increase their usefulness to device and circuit designers. Based on the experimental results, physical models are suggested for the reordering processes which occur during the annealing of neutron damage. Electron density is shown to be the most important factor governing the rate of transient annealing. Annealing factors are estimated for very early times (1 microsec) following neutron exposure. Suggestions are made to minimize the effects of transient annealing on devices. Author (NSA)

N70-42914# Rochester Univ., N.Y. Dept. of Physics and Astronomy.

SINGULARITY STRUCTURE OF BROKEN CHIRAL SYMMETRY

S. Okubo and V. S. Mathur 19 Jun. 1970 32 p refs Presented at the 15th Intern. Conf. on High Energy Physics, Kiev, USSR

(Contract AT(30-1)-875)

(UR-875-311; CONF-700806-10) Avail: NTIS

General properties of the Gell-Mann model for chiral W(3) and SW(3) symmetry breakings were investigated. From a study of the two point functions, it was concluded that the theory may have singular points as a function of the coupling parameter which breaks the symmetry, provided that in the exact SW(3) limit the symmetry is realized through the emergence of Goldstone bosons. This conclusion is independent of dynamical details and depends only upon general principles currently accepted. The compatibility of the theory with the transformation recently discovered by Kuo is shown to arise partly due to the presence of such singular points. A detailed investigation based upon both linear and nonlinear realizations of the chiral group shows that physical quantities such as masses and scattering amplitudes need not be manifestly invariant under the Kuo transformation which is represented as a highly singular operation in the case of the nonlinear theory. Author (NSA)

N70-42915# California Inst. of Tech., Pasadena.

REVIEW OF EXOTIC MESONS

Jonathan L. Rosner (Minnesota Univ.) [1970] 35 p refs Presented at the Exptl. Meson Spectry. Conf., Philadelphia, 1-2 May 1970

(Contract AT(11-1)-68)

(CALT-68-262; CONF-700525-2) Avail: NTIS

The review of exotic mesons covers some theories of exotic mesons, exotic exchanges, spectroscopic evidence for type-1 exotics, and the evidence for type-2 and -3 exotics. No conclusive evidence is found for the existence of exotic mesons. NSA

N70-42916# Purdue Univ., Lafayette, Ind. Dept. of Physics.

DECAY OF SOME HIGH MASS BOSONS TO PION(+) PION(0)

S. L. Kramer, H. R. Barton, Jr., L. J. Gutay, S. Lichtman, D. H. Miller et al [1970] 13 p refs

(COO-1428-176) Avail: NTIS

Evidence is presented for three boson structures with masses 1.65, 1.97, and 2.16 GeV/c and widths less than 80 MeV/c from a study of the reaction pion(+) proton yields proton pion(+) pion(0) at 13.1 GeV/c. These structures are shown to have I sub G = 1(+), therefore excluding even J assignments. This result favors the interpretation of the 1.97 state as a member of the A sub 2 daughter trajectory. Author (NSA)

N70-42917# Purdue Univ., Lafayette, Ind. Dept. of Physics.

DIFFRACTIVE PROCESS IN PION(-) PROTON INTERACTIONS AT 100 GeV/c

Robert B. Willmann 15 Jun. 1970 7 p refs Sponsored in part by AEC

(COO-1428-213) Avail: NTIS

A study of diffractively produced hadron systems from 100 GeV/c pion(-) interactions in a 15 foot hydrogen bubble chamber is proposed. Primary interest is in the 4C reactions pion(-) proton yields proton pion(-) pion(-) pion(+) and pion(-) proton yields proton pion(-) pion(-) pion(-) pion(+) pion(+). Use of the chamber as a missing mass spectrometer for other four and six pronged interactions is proposed, also. A total of 500,000 photographs is requested. Author (NSA)

N70-42924# Naval Weapons Lab., Dahlgren, Va. Warfare Analysis Dept.

A STRETCH COMPUTER PROGRAM PROVIDING MASS SPECTROMETRY TABLES FOR CHEMICAL AGENT ANALYSIS

Robert C. Belsky and Louise P. Gordon May 1970 31 p refs

(AD-709913; NWL-TR-2404) Avail: NTIS CSCL 7/4

A computer program is described which generates tables that are useful in the interpretation of mass spectra. The tables give the molecular configurations of organic compounds that contain carbon and possibly any hydrogen, nitrogen, oxygen, and phosphorous, and are arranged in order of integer molecular mass computed by the use of each elements nearest integer atomic mass. For each configuration exhibited in the tables, the mass balance and certain ratio values are also computed. Mass balance is defined as the difference from the integer molecular mass, as described above, of the total computed mass of a molecular. The ratio values are the proportionality, due to the presence of isotopes, of the expected relative abundances exhibited by the spectrum in the vicinity of the molecular mass to charge (M/C). A FORTRAN IV listing of the program, and flow charts are included. Author (TAB)

N70-42941# Rome Univ. (Italy). Inst. of Physics.

ON THE TIME-DEPENDENT HARMONIC OSCILLATOR

E. Salusti and F. Zirilli 10 Feb. 1970 9 p refs *Its* Nota Interna 256

Avail: NTIS

The importance of the quantum harmonic oscillator has been stressed by the analysis of the motion of a charged particle in a magnetic field which has a fixed direction but changes its intensity with time. Some easily soluble potentials are described, based on Dirac's method. ESRO

N70-42952# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.

THE EXCITATION AND IONIZATION OF IONS BY ELECTRON IMPACT Technical Progress Report, 1 Sep. 1969-31 May 1970

J. W. Hooper, R. K. Feeney, J. C. Majure, D. McPherson, and M. O. Pace 31 May 1970 27 p refs

(Contract AT(40-1)-3027)

(ORO-3027-16) Avail: NTIS

The status of work on four experimental programs is reported: (1) development of facilities and techniques for determination of electron collision data from magnetoplasma transient response studies; (2) energy loss of singly charged lithium ions upon passage through thin films; (3) determination of absolute cross sections for excitation of Ba(+) ions by electron impact for electron energies near threshold for the processes of interest; and (4) determination of absolute cross sections for ionization of Ba(+) ions by electron impact for electron energies from below threshold to 1000 eV. Progress in equipment preparation and data taking for each program is described briefly; no data are included. NSA

N70-42957# Sandia Corp., Albuquerque, N.Mex.

MAGYAR: A SINGLE COLLISION MODEL NEUTRON HEATING CODE FOR COMPONENT DESIGN (USER'S

MANUAL)
Thomas T. Shishman Jun. 1970 51 p refs
(SC-DR-69-318) Avail: NTIS

A heating code was written to enable component designers to calculate specific energy depositions from neutron irradiations, using the CDC 6600 computer. Three interactions are treated: neutron elastic scattering; inelastic scattering; and neutron-in, charged particle-out reactions. Since the energy absorption coefficients for the various elements, based on these three processes, are not documented, an additional code was generated to compute these for the 59 elements considered most relevant to component work, and the results stored on magnetic tape. The input and output formats of the code were held simple to encourage even those designers who are not normally machine-oriented to use the code for proper consideration of neutron irradiation effects. Author (NSA)

N70-42958# Los Alamos Scientific Lab., N.Mex.
ELEMENTARY REVIEW OF ANGULAR MOMENTUM
P. W. Keaton, Jr. May 1970 53 p refs
(Contract W-7405-eng-36)
(LA-4394) Avail: NTIS

A set of notes is presented to refresh the reader on basic concepts of angular momentum in quantum mechanics. The purpose is to review background information necessary for a study of polarization phenomena in nuclear interactions. Tedious calculations are carried through as an illustration of general cases. The appendixes are self-contained so that they may be used conveniently as references. Author (NSA)

N70-42959# Purdue Univ., Lafayette, Ind. Dept. of Physics.
NEUTRINO INTERACTIONS IN THE DEUTERIUM-NEON 14 FOOT DOUBLE BUBBLE CHAMBER
10 Jun. 1970 11 p refs
(COO-1428-211) Avail: NTIS

The interactions of high energy neutrinos in the 14 foot bubble chamber are studied. The target chamber will be filled with deuterium and the surrounding region filled with nearly pure neon. An exposure of one million pictures is requested, in order to map out the s and t dependences of the basic interactions in which neutrinos participate. Author (NSA)

N70-42960# Purdue Univ., Lafayette, Ind.
ETA-ETA' MIXING ANGLE OF −24 DEG FROM A REGGE-MODEL FIT TO CROSS SECTIONS
W. J. Miller, J. A. Gaidos, F. J. Loeffler, and J. H. Campbell (Argonne Natl. Lab.) [1970] 7 p refs Presented at the 15th Intern. Conf. on High Energy Physics, Kiev, USSR
(COO-1428-214; CONF-700806-7) Avail: NTIS

Application of a Regge model used for pion nucleon yields nucleon eta meson to recent pion neutron yields proton negative eta meson data gives a ratio of coupling constants for the two reactions. From this ratio an eta meson to negative eta meson mixing angle of minus 24 deg plus or minus three degrees is obtained in agreement with the linear mass formula. Author (NSA)

N70-42961# Purdue Univ., Lafayette, Ind. Dept. of Physics.
OBSERVATION OF N*(1720) DECAY TO DELTA (1236) PION FROM PION(+) p INTERACTIONS AT 13.1 GeV
R. B. Willmann, J. W. Lamsa, J. A. Gaidos, and C. R. Ezell [1970] 13 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev Sponsored in part by AEC
(COO-1428-215; CONF-700806-13) Avail: NTIS

Evidence is presented for the production of baryon resonance (1720) (M = 1719 plus or minus 6 MeV, Gamma = 63 plus or minus 12 MeV) and subsequent decay to Delta (1236) pion in positive pion proton interactions at 13.1 GeV. Analysis of the sequential decay baryon resonance (1720) yields positive-positive-Delta negative pion yields proton positive pion negative pion limits the spin to values greater than 3/2. Author (NSA)

N70-42972# Chicago Univ., Ill.
POMERANCHUK TERM IN THE DUAL QUARK MODEL
Peter G. O. Freund May 1970 16 p refs
(Contract AT(11-1)-264)
(COO-264-547; EFI-70-27) Avail: NTIS

The role of loop diagrams with an odd number of twisted vertices in ensuring the validity of Pomeranchuk's theorem is pointed out. A mechanism to boost the Pomeranchuk intercept to one is proposed. This mechanism relies upon the necessary existence of exotic hadrons in a dual theory. Author (NSA)

N70-43042*# Southern Methodist Univ., Dallas, Tex. Dept. of Physics.
ABSOLUTE NEUTRON CROSS SECTIONS FOR THE PRODUCTION OF Na 24 ISOMER FROM MAGNESIUM AND ALUMINUM Final Report
George N. Salaita Oct. 1970 39 p refs
(Grant NGL-44-007-006)
(NASA-CR-110933; SMU-83-24) Avail: NTIS CSCL 20H

The cross sections for the Mg-24(n,p) Na-24m and Al-27(n,alpha) Na-24m reactions were measured using the cyclic activation technique and a high energy resolution Ge(Li) gamma ray detector. The absolute activation cross sections were also measured for the Al-27(n,p) Mg-27 and Al-27(n,alpha) Na-24 reactions at 14.6 MeV neutron energy. The results were: Mg-24(n,p) Na-24m, 138 + or − 14 mb; Al-27(n,alpha) Na-24m, 65 + or − 6 mb; Al-27(n,p) Mg-27, 75 + or − 6 mb; and Al-27(n,alpha Na-24, 111+ or − 9 mb. These results are compared with similar measurements of other authors Author

N70-43075*# General Electric Co., Philadelphia, Pa.
MOLECULAR BEAM SURFACE INTERACTION Final Report
[1970] 64 p refs
(Contract NASw-1588)
(NASA-CR-110871) Avail: NTIS CSCL 20G

The experimental investigation of momentum transfer between neutral particles and solid surfaces was broadened to include (1) higher beam energies, (2) varying angles of incidence, (3) wider selection of surface conditions, and (4) measurements of the spatial distribution of the reflected particles. The results show that, in general, particles scattered from either clean or contaminated noncrystalline surfaces do not have a cosine spatial distribution. At grazing angles of incidence, the tendency to a lobular pattern ipcreases both with incident energy and increasing angle of incidence. This behavior is consistent with momentum transfer or drag measurements on the test surfaces. Even at normal incidence the flux distribution is found to be noncosine. The flattening which was observed may account for the fact that values of the force ratio at zero deg were occasionally measured to be less than unity. In all cases the lobular distributions became less pronounced (more cosine like) with surface aging. Author

N70-43077# Purdue Univ., Lafayette, Ind. Dept. of Physics.
THE REACTION PION DEUTERON YIELDS DEUTERON PION(+) PION(+) PION(−) AT 13 GeV/c
K. Paler, R. C. Badewitz, H. R. Barton, Jr., D. H. Miller, T. R. Palfrey, Jr. et al [1970] 10 p Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, USSR
(COO-1428-220; CONF-700806-12) Avail: NTIS

Preliminary results obtained for the reaction pion(+) deuteron yields deuteron pion(+) pion(+) pion(−) at 13 GeV/c are presented. The reaction is dominated by the production of three pion states with masses near the rho meson pion threshold. The neutral dipion effective mass spectrum is dominated by neutral rho meson production. The reaction is very peripheral being characterized by the deuteron differential cross section of A exp (29t). Author (NSA)

N70-43083 California Inst. of Tech., Pasadena.
PARTICLE KINETICS OF GAS-SOLID PARTICLE MIXTURES
Roger Allison Haas (Ph.D. Thesis) 1969 234 p

Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 70-1414

The interaction of a normal gas dynamic shock wave with a gas containing a distribution of small solid spherical particles of two distinct radii, sigma sub 1 and sigma sub 2, is studied (1) to demonstrate that the methods of kinetic theory can be extended to treat solid particle collision phenomena in multi-dimensional gas-particle flows; (2) to elucidate some of the essential physical characteristics associated with particle-particle collision processes; and (3) to give some indication regarding the importance of particle collisions in particle-laden gas flows. It is assumed that upstream of the shock wave particles sigma sub 1 are uniformly distributed while particles sigma sub 2 are nonuniformly distributed parallel to the shock face and in much smaller numbers than particles sigma sub 1. Dissert. Abstr.

N70-43092# Oak Ridge National Lab., Tenn.
NEUTRAL BEAM ION HEATING IN ORMAK 2
G. G. Kelley, O. B. Morgan, H. Postma, and H. K. Forsen (Wisconsin Univ., Madison) Jul. 1970 18 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3076) Avail: NTIS

Ion and electron temperatures of several keV should be obtained from a system of 4 injectors in ORMAK 2. Calculations of the expected performance of the system are described. Author (NSA)

N70-43095*# Rensselaer Polytechnic Inst., Troy, N.Y. Nuclear Science Dept.
INVESTIGATION OF THE STRUCTURE OF RADIATION DAMAGE IN LITHIUM DIFFUSED SILICON Midway Progress Report, 1 Jan. – 1 Jun. 1970
John C. Corelli 1 Jun. 1970 26 p refs Prepared for JPL
(Contract NAS7-100; JPL-952456)
(NASA-CR-110890) Avail: NTIS CSCL 18H

A brief description is given of instrumentation and methods used in the study of radiation damage in lithium-diffused silicon in which infrared photoconductivity and infrared spectroscopy are used as the probes. The defects were induced in the material by 1.5 MeV electrons at 300 K. Also included is a detailed description of the cryostat to be used in cold temperature electron irradiations which permits both electrons of < 3 MeV and light of 1 to 15 microns to irradiate the sample. Author

N70-43104# Washington Univ., Seattle. Dept. of Physics.
NON-EXISTENCE OF SCHWINGER TERMS IN SPINOR QUANTUM ELECTRODYNAMICS
David G. Boulware and Jack Herbert [1970] 24 p refs
(RLO-1388-576) Avail: NTIS

The equal time commutator between the space and time components of the electromagnetic current in spinor electrodynamics is calculated, to order alpha, using the technique of Johnson, Low, and Bjorken; it is found to be a c number. An argument is presented which indicates that the commutator is a c number in all orders of perturbation theory. Author (NSA)

N70-43105# Princeton Univ., N.J. Elementary Particles Lab.
DISCUSSION OF EXPERIMENTAL TESTS OF HIDDEN VARIABLE THEORY, WITH APPLICATION TO AN INTERFERENCE EXPERIMENT
M. R. Nelson, D. M. Warrington, and George T. Reynolds 5 Dec. 1969 18 p refs
(Contract AT(30-1)-3406)
(NYO-3406-17) Avail: NTIS

Two quantum mechanical observables that commute with one another are considered. Consideration of correlated observables led Einstein et al. to question the measurement assumption. Some examples of these observables and their various quantities are discussed. NSA

N70-43106# Los Alamos Scientific Lab., N.Mex.
MEDIUM-ENERGY PHYSICS PROGRAM Quarterly Status Report, Period Ending 30 Apr. 1970
Jun. 1970 42 p refs
(Contract W-7405-eng-36)
(LA-4463-MS) Avail: NTIS

A summary of research on the medium-energy physics program at Los Alamos is presented for the period ending April 30, 1970. This review covers the accelerator structures, the RF power system, accelerator control and instrumentation, accelerator physics, the experimental area, LAMPF users group and scheduling and facility construction, and physics research. NSA

N70-43110# Utrecht State Univ. (Netherlands). Analytical Chemistry Lab.
COMPTON SCATTERING IN X-RAY SPECTROMETRY [DE COMPTON-VERSTROOIING IN DE RONTGENSPECTROMETRIE]
Harm Klunder (Ph.D. Thesis) Jan. 1970 120 p refs In DUTCH; ENGLISH summary
Avail: NTIS

Theoretical explanations for recent applications of Compton scattering in X-ray spectrometry are discussed. The relation between the ratio of the intensities of the coherently and incoherently scattered radiation and the crystal sample composition is examined and a factor, independent of angle, is deduced. The theoretical values of the intensity ratio were calculated for a few samples using electronic scattering powers and they agreed with the experimental data. Possible applications are also discussed. ESRO

N70-43140# Purdue Univ., Lafayette, Ind.
A MULTIPERIPHERAL ANALYSIS OF THE REACTION PION(+) d YIELDS p(SUB s) p 3 PION AT 13 GeV/c
H. R. Barton, Jr., R. C. Badewitz, D. H. Miller, K. Paler, T. R. Palfrey, Jr. et al Aug. 1970 18 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev Sponsored in part by AEC
(COO-1428-225; CONF-700806-15) Avail: NTIS

The reaction was studied at 13 GeV/c incident pion(+) momentum in a 260,000 picture exposure taken in the 82-inch deuterium bubble chamber at the Stanford University Linear Accelerator. The data are characterized by meson charge exchange, i.e., a neutral pion is produced at low momentum transfer relative to the pion(+) beam. This characteristic of the reaction plus charge exchange at the nucleon vertex prohibit Pomeranchuk exchange. A triple-peripheral model which is capable of reproducing the data is discussed. The momentum transfer and effective mass distributions observed in this experiment are compared with model calculations. Author (NSA)

N70-43152# Purdue Univ., Lafayette, Ind.
ON THE NEUTRAL DIPION MASS DISTRIBUTIONS IN THE REACTIONS PION(+) NEUTRON YIELDS PROTON PION(+) PION(−) AND PION(−) PROTON YIELDS DELTA(++) PION(+) PION(−) AT 13 GeV/c
K. Paler, R. C. Badewitz, H. R. Barton, Jr., D. H. Miller, T. R. Palfrey, Jr. et al [1970] 10 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, USSR
(COO-1428-219; CONF-700806-11) Avail: NTIS

A study of the neutral dipion effective mass distributions produced in the reactions a) pion(+),neutron yields proton,pion(+), pion(−) and b) pion(+),proton yields Delta(++), pion(+), pion(−) is presented. By dividing the dipion distributions in reactions a) and b) by the dipion background distributions obtained from the reactions pion(+),proton yields neutron, pion(+), pion(+) and pion(−), proton yields Delta(++), pion(−), pion(−) respectively similar dipion distributions are obtained. These distributions are qualitatively described by a Veneziano amplitude. Author (NSA)

N70-43153# California Inst. of Tech., Pasadena.
QUARK SPIN AND DUALITY
R. Carlitz, S. Ellis, P. G. O. Freund, and Satoshi Matsuda Jun. 1970 12 p refs
(Contract AT(11-1)-68)
(CALT-68-260) Avail: NTIS

Quark spin is incorporated into the Veneziano N-point function. Parity doubling and new ghosts are avoided by the introduction of fixed J-plane cuts. All resonances couple according to U(6)w cross multiplication O(2) sub L sub z, and the model factorizes with essentially the same degeneracy as the usual Veneziano amplitude. As a consequence of the coupling symmetry, the amplitude's singularities at s = infinity and t = infinity are such that the amplitude has a finite background contribution. Author (NSA)

N70-43155# California Inst. of Tech., Pasadena.
HADRON SYMMETRY FROM CROSSING RELATIONS
Jonathan L. Rosner [1970] 57 p refs Presented at the Meeting of the Am. Phys. Soc., Washington, D.C.
(Contract AT(11-1)-68)
(CALT-68-254; CONF-700419-2) Avail: NTIS

The discussion of hadron symmetry from crossing relations reviews the quark model for the consistency between low-energy and high-energy descriptions of hadron scattering, exchange degeneracies, predictions, results on spins, and recent experiments on total cross sections at higher energies and regarding exotic states. NSA

N70-43164# New York Univ., N.Y. Radiation and Solid State Lab.
THE INTERACTION OF RADIATION WITH MATTER
Progress Report, 1 Feb. 1970–31 Jan. 1971
Werner Brandt and Martin Pope Nov. 1969 99 p refs
(NYO-2962-8) Avail: NTIS

Research progress is reported on heavy ion physics, subexcitation processes, and energy transfer and ionization processes in organic materials. NSA

N70-43174# Purdue Univ., Lafayette, Ind.
HIGH MASS BOSON PRODUCTION IN PION(+) PROTON INTERACTIONS AT 13.1 GeV/c
D. H. Miller, S. L. Kramer, C. R. Ezell, J. A. Gaidos, L. J. Gutay et al. [1970] 12 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, USSR
(COO-1428-222; CONF-700806-8) Avail: NTIS

The R, S, T, U, and X meson resonance production in positive pion + proton interactions at 13.1 GeV/c in a bubble chamber is studied and compared with that of the CERN Boson Spectrometer group. Various histograms are shown for these data. NSA

N70-43183# Ballistic Research Labs., Aberdeen Proving Ground, Md. Interior Ballistics Lab.
ELECTRON SPIN RESONANCE STUDIES ON GAMMA-IRRADIATED KMnO4
Kevin J. White May 1970 64 p refs
(AD-710231; BRL-1482) Avail: NTIS CSCL 7/5

Electron spin resonance (ESR) studies were carried out on the radicals produced by the gamma-irradiation of single crystals of KMnO4. A crystal holder has been designed which allows an accurate orientation of the crystal. Analysis of the data yields at least two paramagnetic species. The first radical is produced by room temperature irradiation and gives a single line for each of two inequivalent magnetic sites. There is no resolvable hyperfine structure. The spectrum is tentatively assigned to the MnO2 or the MnO4 radical. The second radical is produced by irradiation at 77K and the spectrum disappears irreversibly at slightly higher temperatures. This spectrum is assigned to the MnO4(-2) radical. The relationship of the radicals observed to the effect of high energy radiation on the decomposition of KMnO4 in the light of current solid state theory is discussed. Author (TAB)

N70-43195# Purdue Univ., Lafayette, Ind. Dept. of Physics.
BOSON STRUCTURES IN THE REACTION PION(+) PROTON YIELDS PROTON PION(+) PION(0) AT 13.1 GeV/c
S. L. Kramer, H. R. Barton, Jr., L. J. Gutay, S. Lichtman, D. H. Miller et al [1970] 14 p refs Presented at the 5th Intern. Conf. on High Energy Phys., Kiev, USSR
(COO-1428-221; CONF-700806-5) Avail: NTIS

Evidence is presented for three boson structures with masses 1.65, 1.97, and 2.16 GeV/c squared and widths less than 80 MeV/c squared from a study of the reaction pion(+) proton yields proton pion(+) pion (0) at 13.1 GeV/c. These structures are shown to have an isotopic spin parity of 1(+), therefore excluding even J assignments. This result favors the interpretation of the 1.97 state as a member of the A sub 2 daughter trajectory. Author (NSA)

N70-43197# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
QUASI TWO BODY REACTIONS AND MOMENTUM TRANSFER DEPENDENCE IN K(+) p INTERACTIONS AT 12.7 GeV/c
R. S. Holmes, J. C. Berlinghieri, M. Farber, T. Ferbel, P. Slattery 2 Jul. 1970 15 p refs Presented at 15th Intern. Conf. on High Energy Phys., Kiev
(Contract AT(30-1)-875)
(UR-875-313; CONF-700806-4) Avail: NTIS

A study of quasi two-body production in K(+)p interactions at 12.7 GeV/c is presented. The reactions (1) K(+)p yields K(*+)(890)p, (2) K(+)p yields K(0) Delta hyperon (++), and (3) K(+) p yields K(*0) (890) Delta hyperon (++) are from a 10 event exposure of the BNL 80-inch HBC. Cross sections and production mechanisms are discussed. Also the momentum transfer dependences in reactions of the kind. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N70-41872# California Univ., Berkeley. Electronics Research Lab.
PLASMA RESEARCH Quarterly Progress Report, 1 Oct.–31 Dec. 1969
31 Dec. 1969 77 p refs
(Contract AT(11-1)-34; Grants AFOSR-1754-69; NSF GK-2978)
(UCB-34-P-128-14; QR-4) Avail: NTIS

Research was concerned primarily with the problems of creating, containing, and heating high-temperature plasmas. The research involves studying the physical and electromagnetic properties, stability, and radiation of these plasmas. A low-temperature plasma is used as an analogue to study the stability of high-temperature plasmas. The high-temperature plasma research facility consists of a 250,000-joule capacitor energy-storage bank and related control system. The bank serves either of two magnetic-mirror compression experiments that require peak magnetic fields in excess of 50,000 gauss. The low-temperature plasma facility is an alkali-metal vapor plasma device. It is used to study the stability of low-temperature plasmas in various magnetic field and plasma configurations, in a density regime that approximates a number of features of a high-temperature plasma. Complementary to the experiments are a wide range of theoretical studies. Author (NSA)

N70-41880*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LASER-GENERATED PLASMA AS A SPECTROSCOPIC LIGHT SOURCE

Francisco P. J. Valero, David Goorvitch, Boris Ragent, and Benjamin S. Fraenkel Washington Oct. 1970 18 p refs

(NASA-TN-D-6048; A-3371) Avail: NTIS CSCL 20I

The spectra emitted by laser generated plasmas were studied in the spectral region from about 40 to 4000 A. The radiating regions of the plasma were spatially resolved using either a stigmatic normal incidence spectrograph, or an astigmatic grazing incidence spectrograph and crossed slit apparatus, depending upon the wavelength region. Both emission and absorption spectra were observed for highly ionized atoms. Both line shifts and strong asymmetries were observed. The continuum spectra radiated by the core of the plasma were used to perform absorption experiments in the soft X-ray region. Features of the laser generated plasma light source that aid in the interpretation of spectra are discussed. The laser produced plasmas have several unique characteristics that prove to be desirable and convenient for spectroscopic work. Author

N70-41892*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GYROSYNCHROTRON RADIATION AND ITS TRANSFER IN A MAGNETOACTIVE PLASMA

Kunitomo Sakurai Sep. 1970 38 p refs Submitted for publication

(NASA-TM-X-65352; X-693-70-340) Avail: NTIS CSCL 20I

Gyrosynchrotron radiation fields from mildly relativistic electrons in a magnetoactive plasma are asymptotically calculated using the Green tensor and the Fourier transformation. These fields consist of the two components which correspond to the ordinary and extraordinary modes. Taking into account these fields, the emissivities and the absorption coefficients from an arbitrary distribution of electrons are calculated. The transfer of electromagnetic energy takes place along a direction different from that of the wave normal since the radiation fields have a nonvanishing component along the direction of the wave normal. Consideration is given to the problem of radiative transfer in relation to the Stokes parameters. Author

N70-42055# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.

PHYSICS OF QUIESCENT PLASMAS

Norman C. Jen and Gert Auer 4 May 1970 46 p refs

(Contract F61052-70-C-0014)

(AD-709230; SR-71; AFOSR-70-1918-TR) Avail: NTIS CSCL 20/9

The report gives a review on experimental work on the Q-machine at The City University of New York and on its theoretical interpretation. First the basic principle of the Q-machine and a simple theoretical description is given, and a short recapitulation of probe theory is presented. Experiments on edge oscillations are described and a theory is given which identify them to be of Kelvin-Helmholtz type. In order to study phenomena occurring at weak magnetic fields the plasma cameras has been developed. By means of this new technique the formation of convective cells has been observed and has been also derived from a simple fluid model. At last some results on the work concerning the helical instability are discussed. Author (TAB)

N70-42057# Gosudarstvennyi Komitet po Ispolizovaniyu Atomnoi Energii, Moscow (USSR).

HYDROMAGNETIC STABILITY OF A CURRENT CARRYING PLASMA COLUMN IN A STRONG LONGITUDINAL MAGNETIC FIELD

V. D. Safranov Oct. 1969 26 p refs

(NP-TR-1863) Avail: NTIS

Earlier conclusions relating to the hydromagnetic stability of a current-carrying plasma column in a strong longitudinal magnetic field based on investigating homogeneous and other special current distributions, are extended and refined. It is shown that, when B sub s much greater than B sub theta, the hydromagnetic perturbations leading to instability are clearly divided into localized flute perturbations and nonlocal surface-wave-type perturbations. In a plasma with free boundary, the main part is played by perturbations of the second type. The principal result is the demonstration that complete stabilization of these perturbations is possible, given a sufficiently rapid radial drop of the current density. The criteria for dissipative instabilities with reference to Tokamak-type systems are also discussed. Author (NSA)

N70-42059# Akademiya Nauk SSSR, Novosibirsk.

SOME ASPECTS OF HEATING A PLASMA BY A STRAIGHT DISCHARGE CURRENT

V. S. Koydan, A. N. Papyrin, A. G. Ponomarenko, and B. Ya. Yablochnikov Sep. 1969 10 p refs Preprint

(NP-TR-1862) Avail: NTIS

New experimental results on the turbulent heating of plasma by the current of a straight discharge are reported. It is shown that for different current shapes the potential drop in the plasma column is concentrated in a region of approximately 5 cm and may move along the discharge gap. The maximum anomalous resistivity and gap voltage coincide with the instant of the abrupt drop of the current, and this moment coincides with the return electron current to the cathode. The onset of turbulence is characterized by a spreading of the plasma column to the chamber walls. Possible causes of the observed effects are suggested. Author (NSA)

N70-42106*# Texas Univ., Dallas.

PLASMA MEASUREMENTS WITH THE RETARDING POTENTIAL ANALYSER ON OGO 6

W. B. Hanson, S. Sanatani, D. Zuccaro, and T. W. Flowerday Jun. 1970 51 p refs Submitted for publication

(Contract NAS5-9311)

(NASA-CR-114237; SP-70-016) Avail: NTIS CSCL 20I

The nature of the results from the retarding potential analyzer on OGO 6 are described. The device appears capable of measuring ion temperature to an accuracy of better than 10 percent in a quiet ionosphere. In the dawn-dusk plane the ion temperature is observed to vary from 1000 K to 4000 K, the higher temperatures being associated with higher altitudes in the winter hemisphere. Molecular ions are detected near perigee (400 km), but their concentrations seldom exceed one percent of the O(+) ion concentration. At mid-latitudes and higher altitudes (>700 km) the lighter ions H(+) and He(+) are both present at approximately the O(+) concentration but their relative importance decreases near and in the polar regions. Both polar regions display large spatial fluctuations in ion concentration and this behavior extends somewhat into the plasmasphere. The device also operates in a mode that examines the horizontal changes in ion concentration (fractional changes as small as 0.001 can be observed) with a spatial resolution from 350 meters to as small as 40 meters, depending on the telemetry rate. Author

N70-42108# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.

ANALYSIS OF ELECTROPHILIC EFFECTS BY ELECTROSTATIC PROBES

T. Luzzi and R. Jenkins Sep. 1970 40 p refs

(RE-391) Avail: NTIS

A theory is derived for a new electrostatic probe technique for determining the depletion of electrons in a plasma. The technique uses the positive ion saturation currents and the difference of floating potential. No negative species saturation current measurement is made. The technique is implemented that all complicated chemical kinetics associated with the electron-attaching gas and plasma are avoided. The utility of the technique was demonstrated in an arc jet experiment in which a readily measurable change in probe floating potential was observed; an indication that the local electron density was significantly reduced by electron

attachment to form negative ions. The arc jet was found to provide a satisfactory flow field for investigation of the effectiveness of various electrophilic gases. Design modifications for future experiments are suggested. Author

N70-42153# Boeing Scientific Research Labs., Seattle, Wash.
ELECTROMAGNETIC CONFINEMENT AND PENETRATION OF AN OVERDENSE PLASMA
R. B. Hall and R. A. Gerwin May 1970 20 p refs
(AD-709349; D1-82-0977) Avail: NTIS CSCL 20/9

For a simple model, it is possible to compute the self-consistent confinement and penetration of an energetic electron plasma by an RF field of large amplitude, when the quantity (v/c) ((omega sub p)/omega) is of order unity or greater, where v is a characteristic electron speed, omega sub p is the plasma frequency, and omega is the RF frequency. Previous theories concerning nonlinear behavior of electromagnetic waves in plasmas have required this quantity to be very small compared to unity. Author (TAB)

N70-42312# Boeing Scientific Research Labs., Seattle, Wash.
DYNAMIC AND STEADY-STATE INJUNCTION OF ELECTRON-HOLE PLASMA IN p-TYPE InSb
B. Ancker-Johnson and William P. Robbins Apr. 1970 53 p refs Supported in part by NSF Prepared in cooperation with Wash. Univ., Seattle
(AD-709316; D1-82-0960) Avail: NTIS CSCL 20/12

Potential measurements as a function of time and space show in detail the passage of an injected electron-hole plasma front, and the eventual establishment of a nonequilibrium steady-state in a long bar of p-type InSb at 77K. All the observed dynamic and steady-state properties of double injection into p-InSb are in good agreement with theory except for the constancy of the current magnitude at the front arrival and the form of the dependence of electric field on distance. TAB

N70-42339# International Centre for Theoretical Physics, Trieste (Italy).
SIMILARITY ARGUMENTS FOR HIGH-FIELD ELECTRICAL CONDUCTIVITY IN A PLASMA
T. M. O'Neil Jun. 1970 5 p refs Submitted for publication
(Contract AT(04-3)-34-PA-85-13; Grant NSF GP-9461)
(IC/70/44) Avail: NTIS

Using similarity arguments for a simple electrostatic model, it is shown that the electrical conductivity of a plasma is independent of the electric field for a large enough field i.e. the current and field are linearly related in the high field limit even though the conductivity is completely determined by turbulence processes. ESRO

N70-42341# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
EXPERIMENTAL EVIDENCE OF ELEMENT AND ISOTOPE SEPARATION IN A ROTATING PLASMA
Bjoern Bonnevier 11 Jun. 1970 29 p refs
(Rept-70-08) Avail: NTIS

The strong centripetal acceleration in a rotating plasma, of the order of 5 x 10 to the 10th power m/sq sec, can be used for separating different species of elements and isotopes. An investigation of these effects in a fully ionized plasma in a curved magnetic field, and a method for collecting the separated plasma are described. Author (ESRO)

N70-42384# Bergen Univ. (Norway). Dept. of Applied Mathematics.
KINETIC THEORY OF A WEAKLY COUPLED AND WEAKLY INHOMOGENEOUS PLASMA IN A MAGNETIC FIELD
Jacqueline Naze Tjoetta and Alf H. Oeien Aug. 1969 54 p refs
(Rept-20) Avail: NTIS

A study of the evolution towards continuum of a weakly coupled, weakly inhomogeneous two-component electron-ion plasma in an external electromagnetic field using the multiple-time-scale (MTS) method is presented. The electron-ion mass ratio parameter and a weak inhomogeneity parameter are introduced. Various orderings of these parameters are considered in order to derive a set of macroscopic equations by the MTS method. Author (ESRO)

N70-42385# Bergen Univ. (Norway). Dept. of Applied Mathematics.
HYDRODYNAMIC EQUATIONS FOR A FLR PLASMA
Magne S. Espedal Aug. 1969 38 p refs
(Rept-19) Avail: NTIS

The distribution function for a collisionless plasma is expanded in Hermite polynomials. It is shown that this expansion may be an expansion in epsilon (very much less than one), where epsilon is the ratio of the Larmor radius to the space scale. Therefore Grad's method of closing the moment equations may be used in a finite Larmor radius (FLR) plasma. Sufficient conditions for closure are given for a three dimensional theory for a finite beta-plasma, and the moment equations for one special case are worked out. Author (ESRO)

N70-42398*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONVERSION OF ELECTROSTATIC PLASMA WAVE INTO ELECTROMAGNETIC WAVE: A NUMERICAL CALCULATION OF THE DISPERSION RELATION FOR ALL WAVE LENGTHS
Hiroshi Oya Sep. 1970 33 p refs Submitted for publication
(NASA-TM-X-65364; X-621-70-352) Avail: NTIS CSCL 20I

The dispersion curves have been computed for a wide range of the wave length from the electromagnetic waves to the electrostatic waves in the case of the magnetoactive warm plasma with a Maxwellian velocity distribution function. The computation was carried out mainly for the perpendicular propagation mode. The upper hybrid resonance is the connection point of the electrostatic waves and the electromagnetic waves. The electrostatic waves not associated with the upper hybrid resonance are subjected to electron cyclotron damping when the wave length becomes long. Oblique propagation is allowed for the electrostatic waves in a frequency range from the plasma frequency to the upper hybrid resonance frequency in the long wave length region where Landau damping can be neglected and where the electrostatic mode smoothly connects to the electromagnetic X-mode. Author

N70-42420*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE LASER GENERATED PLASMA AS A SPECTROSCOPIC LIGHT SOURCE
Francisco P. J. Valero, David Goorvitch, Boris Ragent, and Benjamin S. Fraenkel [1970] 28 p refs
(NASA-TM-X-66372) Avail: NTIS CSCL 20I

The spectra emitted by laser-generated plasmas have been studied in the spectral region from about 40 A up to 4000 A. The radiating regions of the plasma have been spatially resolved using either a stigmatic normal incidence spectrograph, or an astigmatic grazing incidence spectrograph-crossed slit apparatus, depending upon the wavelength region. Both emission and absorption spectra were observed for highly ionized atoms. Both line shifts and strong asymmetries were observed. The continuum spectra radiated by the core of the plasma have been used to perform absorption experiments in the soft X-ray region. Features of the laser generated plasma light source which aid in the interpretation of spectra are discussed. The laser produced plasmas have several unique characteristics which prove to be desirable and convenient for spectroscopic work. Author

N70-42433# International Centre for Theoretical Physics, Trieste (Italy).
COLLISIONLESS RELAXATION IN SYSTEMS WITH

COULOMB INTERACTIONS
B. B. Kadomtsev and O. P. Pogutse Jun. 1970 9 p refs Submitted for publication
(IC/70/54) Avail: NTIS

An analytical consideration of the relaxation of the distribution function for systems of particles with Coulomb interactions is given. It takes into account two-particle correlations which correspond to the formation of some macroparticles, i.e. coherently moving regions. It is argued that such a relaxation leads to the Lynden-Bell distribution with an additional high-energy tail. Author (ESRO)

N70-42435# International Centre for Theoretical Physics, Trieste (Italy).
LINEAR MECHANISM FOR THERMAL ENERGY TRANSPORT IN CURRENT-CARRYING PLASMAS
B. Coppi Jun. 1970 10 p refs Submitted for publication
Sponsored by USAEC
(IC/70/53) Avail: NTIS

Collisionless modes extracting electron thermal energy and convecting it radially are considered as a possible explanation of the electron thermal energy radial transport, larger than the one predicted by the proper collisional theory, in confined high-temperature plasmas carrying a current along the magnetic field. Author (ESRO)

N70-42451# International Centre for Theoretical Physics, Trieste (Italy).
A THEORY OF RESISTIVITY IN COLLISIONLESS PLASMA
T. H. Dupree (MIT, Cambridge) Jun. 1970 9 p refs Submitted for publication
(Grant NSF GK-2581)
(IC/70/40) Avail: NTIS

An electron drift driven by an applied constant electric field causes an ion acoustic instability. A steady state is proposed in which ballistic clumps of plasma behave like dressed test particles and collisionally scatter each other. The applied field is balanced by the dynamical friction force on the clumps. Author (ESRO)

N70-42478 Texas Univ., Austin.
COLLISIONAL DRIFT INSTABILITY OF A CURRENTLESS WEAKLY IONIZED MAGNETOPLASMA
Peter Benedict Mumola (Ph.D. Thesis) 1969 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-21864

A linearized two fluid hydrodynamic stability analysis yields a dispersion relation which is analyzed numerically. Oscillations with an azimuthal phase velocity approximately equal in magnitude and in the same direction as the electron diamagnetic drift are predicted to become unstable (onset) once the external magnetic field exceeds some critical value. This instability was observed experimentally in a capacitively coupled radio frequency discharge immersed in a static, uniform magnetic field. The RF discharge was utilized in order to simulate a plasma with no applied axial drift of particles. Stability criteria are displayed graphically in terms of the magnetic field strength, neutral gas pressure, and discharge tube radius. Experimental measurements are found to be in excellent agreement with the predicted values of critical magnetic and phase velocity over a wide range of neutral gas pressures and several different discharge tube radii. Dissert. Abstr.

N70-42494# European Space Research Inst., Frascati (Italy).
NOTE ON THE EXISTENCE OF STATIONARY SHOCK WAVES IN COLLISIONLESS PLASMAS
K. Schindler and D. Pfirsch (Inst. fuer Plasmaphys.) [1970] 14 p refs Submitted for publication
Avail: NTIS

Wave propagation in the x-direction perpendicular to a magnetic field is discussed, the medium being collision free and described by the Vlasov theory. It is shown that there are only two t, y and z-independent unique constants of the motion, and that at least one of them depends on x so fulfilling a necessary condition for the existence of stationary shocks. The existence proof also suggests a practical tool for solving problems. The oblique case is qualitatively different because a uniform upstream state cannot be prescribed owing to the presence of reflected particles. Author (ESRO)

N70-42498# Bergen Univ. (Norway). Dept. of Applied Mathematics.
KINETIC THEORY OF A WEAKLY COUPLED AND WEAKLY INHOMOGENEOUS GAS
Alf H. Oeien and Jacqueline Naze Tjoetta Jun. 1969 29 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 1 – 6 Sep. 1969
(Rept-18) Avail: NTIS

A study of the evolution towards equilibrium of a weakly coupled and weakly inhomogeneous one-component gas using the multiple-time-scale (MTS) method is described. The method is applied to the BBGKY equations and the first three hydrodynamic equations. For one special ordering between the inhomogeneity parameter and the parameter associated with the weak coupling, it was found that the equation for the temperature in the "Burnett approximation must be supplemented with a dissipative term describing the conversion of the particle kinetic energy to correlational electric field energy of the gas. Author (ESRO)

N70-42509# Plasma Sciences Labs., Inc., Van Nuys, Calif.
ABSORPTION CORRECTIONS FOR OPTICALLY THICK PLASMAS Final Scientific Report
H. N. Olsen Wright-Patterson AFB, Ohio ARL Mar. 1970 70 p refs
(Contract F33615-67-C-1071)
(AD-710218; ARL-70-0048) Avail: NTIS CSCL 20/9

A self-consistent, iterative method has been developed for inverting spatially integrated spectral intensities of spectral lines to local emission coefficients with correction for self-absorption. The method is applicable to plasmas which are axisymmetric, exhibit local thermodynamic equilibrium and whose total absorption along the plasma diameter does not exceed approximately 20%. As wavelength profiles of the spectral lines need not be measured, the method can be used to correct existing experimental data obtained with no special consideration having been given to the possibility of a significant self-absorption. A Fortran 4 computer program is included which has been applied to experimental data obtained with the free-burning argon arc plasma at pressures of 0.5, 1.1 and 2 atm. Corrected values for some argon transition probabilities are used to judge the accuracy of the method. Author (TAB)

N70-42511# Aerospace Corp., El Segundo, Calif. Lab. Operations.
THE INFLUENCE OF AN AXIAL MAGNETIC FIELD ON NEUTRON PRODUCTION IN A PLASMA FOCUS DISCHARGE
Melvin J. Bernstein and Francis Hai 15 Jul. 1970 25 p refs
(Contract F04701-70-C-0059)
(AD-710606; TR-0059(6220-50)-2; SAMSO-TR-70-284) Avail: NTIS CSCL 20/9

An axial magnetic field of up to 1200 Gauss was applied to a plasma focus discharge, and the effects on neutron production were investigated. Trapped fluxes of 34000 and 57000 Maxwells reduced the neutron yields by factors of 5 and 10, respectively. The applied field reduced the average energy shift of the axially emitted neutrons, decreased the ratio of the axial neutron flux to radial flux, and extended the length of the neutron source. An increase in the field from 720 to 1200 Gauss did not further reduce the flux anistropy. Streak photography revealed that the minimum plasma radius became larger with increased distance from the anode and that the visible plasma boundary become indistinct at the time of most intense neutron emission. The trapped flux delayed the onset of this intense emission. These results are consistent with an acceleration mode of neutron emission. Author (TAB)

N70-42533# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
MEASUREMENTS OF GROWTH AND DAMPING RATES IN AN INHOMOGENEOUS LOW-BETA PLASMA COLUMN Final Report
G. L. J. Mueller, W. Friz, and R. S. Palmer May 1970 47 p refs
(AD-709878; ARL-70-0080) Avail: NTIS CSCL 20/9

Electrostatic low frequency waves, propagating with a k perpendicular > > k parallel and with frequencies omega < omega sub c (omega sub c = ion cyclotron frequency) in the radial edge of a thermalized, low temperature and low-beta Cs plasma column, can be switched on and off by a fast change of d.c. voltage applied to a column aperture ring. From the oscillation growth and decay connected with the aperture voltage switch, growth and damping rates of this instability were derived. This paper describes the method and the results of wave growth and damping rate measurements as a function of the wave frequency, plasma density, and the potential drop through the plasma column edge. Author (TAB)

N70-42543# International Centre for Theoretical Physics, Trieste (Italy).
PERTURBATION OF MAGNETIC SURFACES IN A ROTATING HIGH BETA TOROIDAL PLASMA
M. Dobrowolny, L. Kovrizhnykh, and R. Pellat Jul. 1970 6 p refs Submitted for publication
(IC/70/56) Avail: NTIS

In a toroidal resistive plasma, in the presence of a radial electric field, one can obtain large perturbations of the magnetic surfaces when the frequency of the azimuthal plasma rotation approaches the Alfven frequency and these are analyzed in this report. Author (ESRO)

N70-42608# Princeton Univ., N.J. Plasma Physics Lab.
ONE MEGAJOULE INDUCTIVE ENERGY STORAGE SYSTEM USING IGNITRON SWITCHING
E. D. Simon and G. Bronner Apr. 1970 30 p
(Contract AT(30-1)-1238)
(MATT-741) Avail: NTIS

The design of the energy storage system is described and operating test results are presented. NSA

N70-42698*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF SINGLE PARTICLE BEHAVIOR IN AN AXISYMMETRIC MAGNETIC FIELD
Ronald J. Schertler Washington Oct. 1970 26 p refs
(NASA-TN-D-6047; E-5737) Avail: NTIS CSCL 20I

Nonrelativistic particle behavior for single interactions with an axisymmetric mirror magnetic field was experimentally investigated. Measurements were made to determine the fraction of an injected electron beam which was transmitted through the mirror region as a function of injection angle for a variety of operating conditions. Measurements were carried out for a range of the adiabatic parameter between 0.027 and 0.22. Over this range results showed that, within the experimental error of this investigation, particle behavior remained adiabatic. Author

N70-42739# International Centre for Theoretical Physics, Trieste (Italy).
ON THE THEORY OF BEAM-PLASMA INTERACTION
B. B. Kadomtsev and O. P. Pogutse Jun. 1970 16 p refs Submitted for publication
(IC/70/45) Avail: NTIS

A new approach to the theoretical treatment of the co-operative phenomena occurring in beam-plasma interactions is proposed. It takes into account the bunching effect related to the trapping of the beam electrons in waves. Author (ESRO)

N70-42838# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
EXPERIMENTAL STUDY OF STREAMING LASER-PRODUCED PLASMAS Progress Report, 1 Apr. 1969 – 30 May 1970
David W. Koopman Jun. 1970 114 p refs
(Contract AT(40-1)-3819)
(BN-658; ORO-3819-2) Avail: NTIS

The progress made in a research program to investigate plasma phenomena in streaming, laser-produced plasmas is reviewed. Particular attention is given to the development of two diagnostic techniques appropriate to the experimental studies being performed. Langmuir probes have been built and tested; theoretical studies bearing on their suitability for use in flowing plasmas are also described. As a complementary technique, Lecher-wire microwave interferometers in configurations useful for measuring electron density in flowing plasmas have been developed. Satisfactory agreement between probes and microwave measurements has been obtained. Using the experimental apparatus, the conditions in laser-produced plasmas streaming in a vacuum 18 to 50 cm from the point at which the laser is focused on a solid target have been measured. Flow velocity, electron density, electron temperature, probe characteristics, and transverse ion flux have been obtained. Author (NSA)

N70-43126*# Princeton Univ., N.J. Guggenheim Aerospace Propulsion Lab.
PULSED ELECTROMAGNETIC GAS ACCELERATION Semiannual Progress Report, 1 Jan. – 30 Jun. 1970
Robert G. Jahn, Woldemar F. Von Jaskowsky, and Kenn E. Clark Jul. 1970 134 p refs
(Grant NGL-31-001-005)
(NASA-CR-110883; Rept-6340; SAPR-16) Avail: NTIS CSCL 20N

Further understanding of quasi-steady accelerator operation has been acquired by various probe and optical techniques. The importance of mass flow to discharge behavior near the anode is illustrated by a sequence of electric and magnetic probe studies which seem to identify the "matched" mass flow as that at which the anode current can just be carried by random electron flux from the adjacent plasma. Spectroscopic studies indicate that insulator erosion increases substantially at mass flows below this matched value, and yield electron density maps for various mass flows and current pulses. Terminal and radiation measurements on a parallel-plate accelerator further illuminate the characteristics of this class of discharge. Various diagnostic devices and techniques, major discharge equipment, and related facilities are described, and a finite jump theory of MPD operation is outlined. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N70-41803# Commissariat a l'Energie Atomique, Grenoble (France). Centre d-Etudes Nucleaires.
USE OF NUCLEAR REACTIONS TO DETERMINE THE QUALITY OF IMPURITIES IN SEMICONDUCTORS [UTILISATION DES REACTIONS NUCLEAIRES POUR DOSER LES IMPURETES IMPLANTEES OU DIFFUSEES DANS UN SEMI-CONDUCTEUR]
Emile Legeon, Andre Bontemps (Grenoble Univ.), Jean Fontenille, and Georges Guernet Feb. 1970 9 p refs In FRENCH Intern. Conf. on Advanced Microelectronics, Paris, 6-10 Apr. 1970
(CEA-CONF-1520; Conf-700414-1) Avail: NTIS

It is shown that nondestructive measurements of impurities in a semiconducting sample can be made through nuclear reactions. As an example, boron concentration in a silicon sample was determined, using the B-11(p,alpha) reaction at low energy. Author (NSA)

N70-41809 California Univ., Davis.
ANHARMONICITY IN ALPHA-IRON: THE THIRD-ORDER ELASTIC COEFFICIENTS
Arthur Douglas Ritchie (Ph.D. Thesis) 1969 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-19640

An experimental system was developed for detection of small changes in the velocity of ultrasound in solid materials. The system was utilized to evaluate the stress dependence of the ultrasonic velocity of single crystal alpha-iron. The experimental system used is a phaselock interferometer capable of a resolution of 20 million. From the measurement of the stress dependence, the third-order elastic constants were determined at 273 and 77 K. A tabulated set of equations is presented that involves a set of eight third-order constants for cubic iron instead of the independent set of six constants more commonly used. The values of the six independent isothermal third-order constants are given. Dissert. Abstr.

N70-41825 Utah Univ., Salt Lake City.
INITIAL SINTERING WITH CONSTANT RATES OF HEATING
Wayne Sanford Young (Ph.D. Thesis) 1969 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-17869

The sintering of several materials was studied by measuring sample densification under constant rates of heating (CRH). It was found that CRH studies are very sensitive to the particle size distribution and surface characteristics of the sample material. The closely sized materials studied gave reproducible results with a single activation energy responsible for densification over wide temperature ranges. Absolute determination of a sintering mechanism is virtually impossible with CRH studies alone. They do give an effective activation energy for sintering and are very sensitive to changes in the sintering mechanism. Data reevaluated on metal powder sintering substantiated a volume diffusion mechanism for silver and iron, while copper exhibited good agreement with grain boundary diffusion kinetics, initially accompanied by surface diffusion. The usefulness of CRH studies, used in conjunction with isothermal experiments of densification and neck growth was firmly established. Dissert. Abstr.

N70-41918*# ITT Research Inst. Chicago, Ill.
ADVANCED EVALUATION OF VACUUM UV DETECTOR-SPECTROSCOPY SYSTEMS FOR CAPSULE REENTRY MEASUREMENTS
Ronald L. Ohlhaber, Howard T. Betz, and Earl H. Klugman Apr. 1970 81 p refs
(Contract NAS1-8992)
(NASA-CR-111776) Avail: NTIS CSCL 20L

Measurements were made on various solid state detectors to predict their performance for incorporation into a vacuum ultraviolet spectrometer that would be onboard a spacecraft designed to reenter the earth atmosphere at a velocity of 50,000 feet per second. Solid state silicon surface barrier and diffused junction photodiodes, phototransistors, and stannic oxide crystals, as detector arrays or individual detectors which could be assembled into arrays were tested in a Seya-Namioka monochromator over the 500 to 2000 angstrom region to determine wavelength sensitivity and other operational characteristics. The detector noise-limited frequency response was established, and fatigue problems were found in all detectors but the phototransistors. The surface barrier array elements on a single silicon chip exhibited considerable crosstalk. An initial spectrometer design incorporating the results of the detector measurements was also considered. Author

N70-42124# Case Western Reserve Univ., Cleveland, Ohio. School of Engineering.
PHONON RENORMALIZATION OF THE MAGNON ENERGY OF AN ITINERANT ELECTRON FERROMAGNET
Peter Kurt George Sep. 1969 116 p refs
(Grant NSF GK-1447)
(TR-69-2) Avail: Issuing Activity

Phonon renormalization of the magnon energy of an itinerant electron ferromagnet is investigated via a Green function treatment of the dynamic spin susceptibility. The itinerant electron model is refined to include the effects of phonons through the one-electron energies. The resulting Hamiltonian is taken as the basis for an equation of motion analysis of the dynamic susceptibility. The associated Green function hierarchy is treated in a generalized random phase approximation resulting in a closed system of three coupled inhomogeneous linear integral equations. Two of these equations are solved exactly and the results substituted into the third yielding an inhomogeneous integral dispersion relation is obtained from the pole of the susceptibility and is examined in the case of a strong ferromagnet with parabolic band structure in the limit that the ratio of band splitting to band width is large. Author

N70-42212# AVCO Corp., Lowell, Mass. Systems Div.
TRANSPORT PROCESSES IN CERAMIC OXIDES Semiannual Technical Report, 16 Jun. – 15 Dec. 1969
Thomas Vasilos, Philip E. Gruber, Jr., William H. Rhodes, and Bernhardt J. Wuensch 15 Jun. 1970 47 p refs
(Contract DAHC15-68-C-0296; ARPA Order 1130)
(AD-709975; AVSD-0067-70-CR) Avail: NTIS CSCL 11/2

Progress is described in a program intended to clarify the nature of mass transport in MgO, a ceramic oxide. The objectives of the program were to (1) prepare single crystals of purity and perfection superior to those presently available, (2) develop techniques permitting study of stable isotope diffusion and apply them to cation self-diffusion in MgO, and (3) extend measurement of impurity cation and cation self-diffusion coefficients to temperatures as close to the melting point of MgO as possible, in an attempt to reveal a region of intrinsic diffusion. Measurements of cation self-diffusion rates obtained for MgO are tentatively represented by a pre-exponential term, Do, equal to 0.0035 sq cm/sec and an activation energy of 3.13 eV, confirming a surprisingly large value reported elsewhere on the basis of data obtained over a very limited temperature range. Diffusion rates in high purity crystals are smaller by a factor of 2, and transport is interpreted as extrinsic. Measurements of Ni(2+) diffusion in MgO have been extended to 2460C. Author (TAB)

N70-42227# Massachusetts Inst. of Tech., Cambridge. Center for Materials Science and Engineering.
HIGH ELECTRIC FIELD TRANSPORT IN DEGENERATE n TYPE PbTe AND PbSe
Hugues St-Onge, James N. Walpole, and Robert H. Rediker 8 Jul. 1970 21 p refs
(Contract N00014-67-A-0204-0010)
(AD-709980; TR-6) Avail: NTIS CSCL 20/12

Nanosecond pulse techniques are used to determine velocity-field characteristics of bulk samples of n-type PbTe and n-type PbSe at 77K and 4.2K for carrier concentrations ranging from 1 x 10 to the 17the power/cc to 5 x 10 to the 17the power/cc. At fields of a few hundred volts/cm, a sublinear variation of the velocity with electric field is observed. At higher fields, of about 2500 V/cm and 1000 V/cm for PbSe and PbTe respectively, the velocity field curve shows an inflection point. This current runaway is consistent with the occurrence of avalanche multiplication. The results are interpreted in the framework of Strattons theory for polar semiconductors. The extensions of the theory to the case of degenerate material with mixed scattering and nonparabolic bands is discussed. A comparison is made with InSb. Author (TAB)

N70-42299* + Rochester Univ., N.Y.
SOLID STATE PHOTODETECTORS AND ASSOCIATED OPTICAL MATERIALS Final Report
Kenneth J. Teegarden 1 Sep. 1970 4 p refs
(Contract NASw-107)
(NASA-CR-114187) Avail: NTIS CSCL 20L

Experimental studies of photoconductivity and photoemission from insulators and semiconductors, as well as studies of luminescence and the optical properties of such materials, are reported. It is noted that contributions were also made to the technology of spectroscopy in the vacuum ultraviolet, principally the design of small grating monochromators and phosphors with flat quantum yields. Considerable effort was expended on the measurement of the absolute quantum efficiencies of such phosphors. The publications and theses resulting from the research are listed.
Author

N70-42302# Bell and Howell Research Center, Pasadena, Calif. Electronic Materials Div.
SEMICONDUCTOR MATERIALS FOR ELECTROLUMINESCENT DIODES AND LASERS Technical Summary Report
Alan G. Thompson May 1970 103 p refs
(Contract N00123-68-C-2131)
(AD-709969) Avail: NTIS CSCL 20/2

The growth of high quality Pb(1-x)Sn(x)Te single crystals by the Czochralski method using liquid encapsulation is described. The control of the carrier density was achieved by growth from non-stoichiometric melts and by isothermal annealing in the presence of a cation-rich vapor. Extensive electrical measurements were made on samples prepared by all of the above techniques, and interpreted in light of the band-crossing model. Thin homo-epitaxial layers of Pb(1-x)Sn(x)Te alloys were prepared by liquid epitaxy and their physical and electrical properties were investigated. For comparison purposes, diffused and Schottky barrier junctions were also prepared and measured. High purity GaAs epitaxial layers on GaAs substrates were grown by the liquid epitaxial technique. Hall effect and capacitance measurements were taken in order to establish the quality and homogeneity of these layers.
Author (TAB)

N70-42321 Northwestern Univ., Evanston, Ill.
MICROWAVE DIAGNOSTICS OF HEAVILY DOPED HIGH MOBILITY SEMICONDUCTORS
Pao-Sun Lu (Ph.D. Thesis) 1969 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 70-111

A wall-replacement cavity technique of microwave diagnostics of magnetoplasma at cryogenic temperatures is developed to study the heavily doped high mobility semiconductors such as n-type InSb and p-type PbTe. Helicon wave formulations and microwave Kerr effect are used in the theoretical analysis. The measurement of scattering factor is made possible and the carrier concentrations are determined indirectly. For less doped high mobility semiconductors, a thin sample is used to observe the dimensional resonance and thus the measurement of scattering factor and carrier concentration are of higher precision. A temperature compensated cavity is designed to provide a stable resonant frequency which is relatively insensitive to the temperature variation. At cryogenic temperatures, the anomalous skin effect of the cavity walls is also taken into consideration.
Dissert. Abstr.

N70-42368*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORY OF THE ANISOTROPIC HEISENBERG FERROMAGNET
Lawrence Flax Washington Oct. 1970 53 p refs
(NASA-TN-D-6037; E-5715) Avail: NTIS CSCL 20L

The development of a formalism for the investigation of phase transitions of the anisotropic Heisenberg ferromagnet is presented. By the use of Green's function theory, the magnetization is determined by several decoupling schemes. A method of calculating the generalized Watson sums is also formulated. The thermodynamic quantity to be studied is the magnetization at and near the Curie point.
Author

N70-42387*# California Univ., Santa Barbara. Solid-State Lab.
FURNACE-TUBE CONTAMINATION
David L. Heald [1968] 20 p refs
(Grant NGR-05-010-041)
(NASA-CR-102836) Avail: NTIS CSCL 20L

The problem areas contributing contaminants to the furnace are identified, and cleaning liquids and procedures used to eliminate contamination are described. The reverse characteristics of diodes fabricated in the furnace were used to check the progress of furnace cleaning. It is concluded that great care and large blocks of time are required to isolate and eliminate contamination in the furnaces in the diffusion room.
N.E.N.

N70-42402# Norwegian Inst. of Tech., Trondheim. Inst. for Theoretical Electro-Technics.
TRANSPORT EQUATIONS FOR ELECTRONS IN TWO-VALLEY SEMICONDUCTORS
K. Bloetekjaer Feb. 1969 29 p refs
(Contract NTNF-B-1770)
(ELAB-TE-121) Avail: NTIS

Transport equations are derived for the particles, momentum, and energy of the electrons in a semiconductor with two distinct valleys in the conduction band, such as GaAs. The collision processes are expressed in terms of relaxation times and their accuracy is improved by considering them as functions of the average kinetic energy rather than the electron temperature. Other transport equations used in the literature are discussed, and shown to be incomplete and somewhat inaccurate in many cases.
Author (ESRO)

N70-42479 California Inst. of Tech., Pasadena.
THE EVALUATION OF E-k CURVES FROM TUNNELING CURRENTS
Thomas Conley McGill, Jr. (Ph.D. Thesis) 1969 92 p
Avail: Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-562

The basis for interpreting I-V data taken on metal-insulator metal structure with insulator thicknesses of less than 100 A is examined carefully. A set of experimental tests for determining the applicability of the equation linking the I-V data to the E-k curve is presented. These tests are found to be a stringent requirement on the experimental data and to support strongly the interpretation of the experimental I-V in terms of the E-k curve for the insulator. A numerical technique for obtaining the E-k curve from I-V data is presented, and applied to data taken on Al-AlN-(Mg,Au) structures where it allows the evaluation of the E-k curve for AlN throughout the forbidden gap.
Dissert. Abstr.

N70-42490 Utah Univ., Salt Lake City.
DIPOLE-DIPOLE INTERACTION IN CALCIUM FLUORIDE DOPED WITH SODIUM FLUORIDE
Robert Duncan Shelley (Ph.D. Thesis) 1969 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-17919

An investigation of the relaxation of electric dipoles produced by doping polycrystal CaF2 with NaF was carried out by means of ionic thermocurrents (I.T.C.). I.T.C. measurements were conducted in the temperature range of 77 K to room temperature. Results show four separate peaks. Three relatively small peaks were observed along with a large, main peak, which significantly broadens as the Na ion concentration increases. The first and fourth peaks are directly dependent on concentration while the second and third seem to vary inversely with concentration. A lattice calculation to the dipole-dipole interaction was made, giving results which predict the main peak and its broadening as a function of concentration

and possibly the lowest small peak. It is observed that the dipole-dipole interaction energy can be as great as .14 eV and manifests itself as a large effect in samples with doping concentrations on the order of one mole per cent NaF. Dissert. Abstr.

N70-42501# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF THE ANOMALOUS HALL EFFECT IN THE CHALCOGENIDE SEMICONDUCTOR GLASS SYSTEMS
Dennis W. Kurtz (M.S. Thesis) Feb. 1970 81 p refs
(AD-710600; GE/EE/70-14) Avail: NTIS CSCL 20/12

A study of one of the groups of amorphous semiconductors, the chalcogenide glasses, was made. From a review of existing literature, the physicochemical, electrical, thermal and optical properties of several of the typical glasses are presented quantitatively and discussed qualitatively. Several of the unusual features of the theorized band structure in these disordered systems are discussed. Several explanations of the Hall effect-Seebeck effect anomalies are reviewed. These include postulates on ambipolar and impurity-type conduction, as well as those on second phases and potential barriers. Several recommendations for further studies are given. TAB

N70-42527# Signals Research and Development Establishment, Christchurch (England).
THE USE OF AN X-RAY SOURCE IN THE OPTICAL SPECTROSCOPY OF RARE EARTH DOPED IONIC MATERIALS
M. R. Brown and W. A. Shand Apr. 1970 24 p refs
(SRDE-70009) Avail: NTIS

The application of X-ray-stimulated luminescence to the detection of trivalent rare earth impurities in ionic materials is discussed and the advantages of using an X-ray source as a pumping source in optical spectroscopy are considered. Author (ESRO)

N70-42534# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RELATIONSHIP BETWEEN THE BREAKDOWN MECHANISM IN BARIUM TITANATE AND COLORATION
N. I. Shefer et al 5 Jun. 1970 12 p refs Transl. into ENGLISH from Uch. Zab. Gos. Ped. Inst. (USSR), v. 21, 1967 p 180–887
(AD-710251; FTD-HT-23-256-70) Avail: NTIS CSCL 20/12

It is shown that the complex time dependence of electrical conductivity in barium titanate single crystals is due to two processes - f- and v-coloration. (The f-centers emanate from the cathode and the v-centers from the anode). The breakdown in barium titanate ceramic below 200 degrees centigrade and in single crystals below 350 degrees centigrade is not thermal. The loss of dielectric strength before breakdown is due to f-coloration, resulting from the injection of electrons from the cathode. Author (TAB)

N70-42600# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
DIFFUSION OF COBALT, NICKEL, AND IRON IN COBALT OXIDE AND NICKEL OXIDE Final Report
Wesley B. Crow Jun. 1970 85 p refs
(AD-709879; ARL-70-0090) Avail: NTIS CSCL 20/12

Self diffusion and impurity diffusion measurements of Co60, Ni63, and Fe55 radiotracers were made in single crystals of nickel oxide and cobalt oxide. The measurements were made by the technique of sectioning the crystals and determining the residual activity remaining in the sample. The diffusion coefficients were measured between 1100C and 1400C in oxygen partial pressures from one to 0.00005 atmospheres. An exact solution for the diffusion equation in the section-and-count experimental technique was derived and a computer program was prepared to plot the solution. Data analysis was accomplished by comparison of experimental profiles to those generated by the computer. A defect model based on total cation vacancy content of the host crystal was proposed to explain the variations of the diffusion coefficients with temperature, oxygen partial pressure and dopant concentrations. Author (TAB)

N70-42601# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
ELECTRONIC BAND STRUCTURE AND THE K AND L X-RAY SPECTRA FROM TiO, TiN, AND TiC Summary Report, Sep. 1969 – Jan. 1970
David W. Fischer Jun. 1970 24 p refs
(AD-709886; AFML-TR-70-134) Avail: NTIS CSCL 20/12

The x-ray K and L sub (III) emission bands and absorption spectra from TiO, TiN and TiC are superimposed and compared with the calculated density-of-states histograms. For TiO the agreement is remarkably good. It is a little less good for TiC and still less for TiN, the disagreements probably being due in part to the presence of more ionicity in the bonding than was considered in the calculations. Results of the comparisons point up the importance of the transition probabilities in contributing to the x-ray spectra and can help indicate needed refinements in the calculated electronic structure. Author (TAB)

N70-42614# Eagle-Picher Co., Miami, Okla. Electronics Div.
RESEARCH IN PURIFICATION AND SINGLE CRYSTAL GROWTH OF 2-6 COMPOUNDS Final Technical Report, 1 May 1968 – 30 Apr. 1970
Richard H. Fahrig, George N. Webb, and Clifford R. Porter Wright-Patterson AFB, Ohio ARL Jun. 1970 143 p refs
(Contract F33615-67-C-1575)
(AD-709890; ARL-70-0106) Avail: NTIS CSCL 20/2

The purification, by multiple treatment steps, of cadmium metal and elemental sulfur is described. Impurities in cadmium, as determined by emission spectrographic and atomic absorption analyses and impurities in sulfur determined by mass spectrographic analyses are given. The preparation of various pure semiconductor materials of the Group II-VI compound type is discussed and tables of analytical data for each are included. The level of impurity concentration in synthesized cadmium sulfide was significantly lowered. The growth of crystals of pure II-VI compounds and mixtures of compounds from the melt in the pressure furnaces is reported. Included are data concerning doping of melt grown crystals with various elemental dopings both singly and in pairs. Experiments on the growth of ZnO crystals by the hydrothermal method are given, along with the preparation and operating procedures used with the autoclave. Gel diffusion crystal growth experiments are also reported. Author (TAB)

N70-42679 Rice Univ., Houston, Tex.
THE CRYSTAL STRUCTURE OF 4-METHYL THIOMORPHOLINE 1, 1-DIOXIDE
John Key Herdklotz (Ph.D. Thesis) 1969 47 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19297

The density was measured by flotation methods to be 1.340 g/cc. while that calculated assuming four molecules per unit cell was 1.341 g/cc. A total of 814 reflections, measured above background, were collected by counter methods while a set of h0l data was collected by film techniques. A Patterson projection, P(u,w,) yielded and x and z sulfur atom coordinates. The remaining non hydrogen atom x and z coordinates were located by synthesizing a fourfold sum function of Patterson P(u,w) maps. A three dimensional Patterson map yielded the y coordinate of the sulfur atoms, while the y coordinates of the remaining non hydrogen atoms were determined by synthesizing a three dimensional electron density function using phases determined by the positions of the sulfur atoms. The hydrogen atoms were located by synthesizing a three dimensional difference map. The structure was refined by the method of full matrix least squares to a weighted R index of 4.1% and a conventional R of 5.5%. Dissert. Abstr.

N70-42719 Carnegie-Mellon Univ., Pittsburgh, Pa.
GROWTH AND ELECTRICAL CHARACTERISTICS OF p Ge-n GaAs HETEROJUNCTIONS
Glenn Odis Ladd, Jr. (Ph.D. Thesis) 1969 192 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-19100

The growth of GaAs on Ge substrates in a close spaced epitaxial growth system using HCl as a transport agent was studied. The quality of the growth at temperatures of 650 C and below is quite orientation dependent. GaAs layers which exhibit carrier concentrations of 10 to the 18th power c m sup −3 and mobilities of 3,500 sq cm/V-sec. can be grown on substrates oriented several degrees off the (111) plane. Germanium doping of the GaAs layers is primarily confined to a two micron layer near the interface. Arsenic doping of the Ge substrates is shown to be caused mostly by diffusion from As. The electrical characteristics of the heterojunction transisitors and diodes grown in this system are as expected from the degenerate doping levels encountered. A theoretical study of the frequency performance of Ge-GaAs heterojunction and Ge homojunction transistors in a state of the art microwave geometry shows that due to limitations of this geometry, the maximum frequency of oscillation of the two types of transistors is similar. Dissert. Abstr.

N70-42728 Rice Univ. Houston, Tex.
HARMONIC FREE ENERGY OF THE FCC AND HCP LATTICES
Dale Alan Huckaby 1969 73 p refs
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-19303

As a test for the convergence of the cell cluster expansion, the harmonic contribution to the Helmholtz free energy for the hexagonal close packed and face centered cubic lattices was calculated in the high temperature limit. The calculations were carried out for first neighbor interactions and for sceond neighbor interactions using a Lennard-Jones potential. Calculations through five particle clusters were extrapolated to three decimal accuracy. The fcc lattice was found to have a slightly lower harmonic free energy at high temperatures. The harmonic contributions to the high temperature Helmholtz free energy for the hcp and fcc lattices were calculated under periodic boundary conditions for chunks of the lattice containing 1000, 8000, and 27,000 particles. Periodic boundary results were calculated including second neighbor interactions for an arbitrary analytic scalar potential. Dissert. Abstr.

N70-42751 Northwestern Univ., Evanston, Ill.
MAGNETO PLASMA EFFECTS IN INDIUM ANTIMONIDE AND TELLURIUM DOPED BISMUTH
Vellayan Ramaswamy (Ph.D. Thesis) 1969 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 70-143

An apparatus to study the magnetoplasma effects in solids at x-band frequencies and at both room and low temperatures was developed. The technique utilizes a unique cylindrical waveguide sample holder with short circuits at both ends. Analytical expressions for the detected power through the sample in terms of the propagation constants of both circularly polarized modes are derived. The apparatus was tested using germanium samples of known transport parameters. An advantage of this technique is that it provides narrow pole gap operation when used in conjunction with a cryogenic dewar using a rectangular tail section. Futhermore, the apparatus can be used to study both the Faraday effect as well as the Helicon effect in solids. Experimental results in InSb with O < or = to B < or = 12 kG have confirmed the restrictions imposed on the Helicon range. No. transmission of power was observed in the experiments on tellurium doped bismuth contrary to the numerical calculations based on the classical model. Dissert. Abstr.

N70-42910# Franklin Inst., Philadelphia, Pa. Research Labs.
STUDIES OF CRYSTAL PERFECTION: TANTALUM SILICIDE AND BERYLLIUM Technical Report, 1 Jun. 1969 – 31 Mar. 1970
C. J. London and J. D. Meakin 31 Mar. 1970 26 p
(Contract AT(30-1)-3716)
(NYO-3716-4; P-C1870-3-1) Avail: NTIS

Activities in a program to develop methods for producing suitably perfect single crystals which are physically large enough to be useful as a monochromator for neutron diffraction, are summarized. Research on production of useable tantalum silicide crystals is briefly described. NSA

N70-42939*# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical Engineering.
STUDY OF SEMICONDUCTOR HETEROJUNCTIONS OF ZnSe, GaAs and Ge, 1 MAY – 31 JULY 1970
A. G. Milnes and D. L. Feucht 31 Jul. 1970 39 p
(Grant NGR-39-087-002)
(NASA-CR-111790) Avail: NTIS CSCL 20L

The fabrication problems and device characteristics of ZnSe-GaAs and Ge-GaAs heterojunctions were studied. The nZnSe-pGaAs structure, in particular, was examined because of its potential in high-temperature solar cells. Scanning-beam electron microscopy and transmission electron microscopy studies show that the perfection of the GaAs substrate and its preparation before growth of the ZnSe are very important in determining the transistor behavior observed. Substitution of a Zn diffusion slow-cool process after growth, for the quench process used earlier, has resulted in current gain from (100)GaAs transistors, which is an orientation that did not previously show gain. Various ZnSe-GaAs structures were pulsed to high current densities in a search for light-emission, but no light output was detected. Success was achieved in the growth of single-crystal ZnS on (111)GaP by the HCl close-spaced transport process. This is a lattice-match heterojunction structure on which almost no previous work has been reported. Author

N70-43024# Army Materials and Mechanics Research Center, Watertown, Mass. Ceramics Div.
GROWTH OF SAPPHIRE DISKS FROM THE MELT BY A GRADIENT FURNACE TECHNIQUE
Frederick Schmid and Dennis J. Viechnicki Apr. 1970 10 p refs
(AD-710235; AMMRC-TR-70-11) Avail: NTIS CSCL 20/2

Single crystal Al2O3 (sapphire) is a candidate material for various window applications. A gradient furnace technique has been developed for the growth of large sapphire disks, 7.3 cm in diameter and 1.5 cm thick, from the melt in molybdenum crucibles. The disks are free of gas bubbles and inclusions and consist of several large pie-shaped grains. Within the grains dislocation densities of 100,000/sq.cm. have been measured. The disks are essentially transparent to radiation from wavelengths of 0.25 micrometers in the ultraviolet spectrum to 4.5 micrometers in the infrared spectrum. Author (TAB)

N70-43063# Pennsylvania Univ., Philadelphia. Dept. of Physics.
MAGNETIC IMPURITIES IN NORMAL METALS Final Report
M. A. Jensen Jun. 1970 9 p
(Grant AF-AFOSR-1149-66)
(AD-710290; AFOSR-70-1784TR) Avail: NTIS CSCL 20/12

The following three areas were investigated: The study of the many-body nature of a magnetic impurity (Cr, Fe, or Co) in a non-magnetic normal metal (Cu) was carried out by using the host nuclei as a probe of both spatial and temporal conduction electron responses to the impurity. Studies of the temperature, magnetic field, and impurity concentration dependence of the response were carried out. The results of this research established the many-body singlet ground state as the most likely model for the ground state of the magnetic impurity problem. Work was carried out to determine the effect of fluctuations on the

superconducting transition temperature and the shape of the transition to infinite conductivity. The major part of this research involved the study of the electric and magnetic field dependence of the superconducting transition in thin films (of aluminum) in which the thermal and depairing fluctuations are most easily observed. The third project was concerned with using the superconducting pairing field in a superconducting thin film to probe the many-body interactions in a normal metal film which is placed juxtaposed to the superconductor and which, therefore, is in the pairing field, within a coherence distance. TAB

N70-43109*# Alabama Univ., Huntsville. Research Inst.
INVESTIGATION OF THE EFFECT OF GRAVITY ON THE GROWTH OF CRYSTAL WHISKERS, PART A Interim Report, 17 Jun. 1969 - 17 Apr. 1970
Jack H. Davis Jun. 1970 36 p refs
(Contract NAS8-24612)
(NASA-CR-102883; IR-1) Avail: NTIS CSCL 20L

The effects of gravity on crystal whisker growth were studied. It is concluded that high aspect-ratio wiskers are best suited for composite strengthening, and are most easily destroyed or broken off by direct gravity force and by gravity-induced convective flow drag. Hydrodynamic calculations show that drag forces due to gas velocity in gravity-induced convection in a typical vapor-deposition growth are large enough to knock down or break off growing whiskers. This is especially true with thin whiskers since the drag force is practically independent of whisker diameter and the wisker rigidity drops inversely proportional to the diameter cubed. The whisker base was found to be the weakest point on the whisker and an electron microscope photograph showed that the base diameter of some iron whiskers was a factor of 5 thinner than the rest of the whisker, which made the whisker 125 times more vulnerable to gravity forces. Cd wiskers grew at 5-g with some reduction in wisker quality believed to the due to increased convection. It is hypothesized that stress induced by gravity is responsible for growth stoppage in squeeze grown whiskers. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N70-41897* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROCESS FOR PREPARING STERILE SOLID PROPELLANTS Patent
Lawrence C. Montgomery inventor (to NASA) and Frank A. Morelli inventor (to NASA) Issued 21 Feb. 1967 (Filed 15 Mar. 1965) 3 p Cl. 149-109 Sponsored by NASA (NASA Case-XNP-01749; US-Patent-3,305,415; US-Patent-Appl-SN-440033) Avail: US Patent Office

The process is described for preparing sterilized solid propellants and sterilized encapsulating materials suitable for medical instruments. In the case of solid propellants, ethylene oxide is added at the same time as the curing agent. The major portion of the ethylene oxide is removed from the propellant during vacuum testing. For sterilized encapsulating materials, ethylene oxide in either the gaseous or liquid state is mixed with an uncured polymeric material which does not react chemically with the ethylene oxide. Medical or other instruments are dipped into a solution of the mixture to form a thin coating on them, and the adherent film is then cured. Sterilization of the instrument occurs during the degassing and curing process. R.B.

N70-42109# Utah Univ., Salt Lake City. Solid Rocket Structural Integrity Information Center.
THE BALLISTIC INTERFACE IN GRAIN CONFIGURATION FOR STRUCTURAL ANALYSIS
John S. Billheimer (Aerojet-Gen. Corp., Sacramento, Calif.) Apr. 1969 40 p refs
(UTEC-SI-68-085) Avail: NTIS

Factors leading to the review of ballistic structural design are discussed. The factors are: quantitativeness of sacrifice in ballistic performance versus probabilistic nature of comparative structural examination, the internal vector surface displacement of ballistic analysis versus the cylindrical chamber coordinates of structural analysis, and traditions of responsibility. The principles of grain design are expressed in terms of the first and second derivative of the burning surface area with respect to distance burnt, the degree of exposure of the chamber wall to propellant flame, and the manner of support of the grain by the case. Examples in star-wagonwheel-dendrite, dogbone and anchor, slotted, conocyl, finocyl, multiperforated and freestanding charge configurations are given. Author

N70-42125*# Stanford Research Inst., Menlo Park, Calif.
AN ANALYTICAL STUDY OF SOLID PROPELLANT COMBUSTION DURING RAPID DEPRESSURIZATION Final Report
Charles E. Wooldridge 15 Jul. 1970 83 p refs
(Contract NAS1-9396; SRI Proj. PHU-8131)
(NASA-CR-111774) Avail: NTIS CSCL 21B

A modification of a solid propellant combustion model previously developed is discussed. The model was modified to contain two heat release zones in the gas phase, one adjacent to the wall governed by the wall temperature and a second primary flame governed by the final flame temperature. Comparisons are shown between predictions of the model and experimental data. It is demonstrated that the calculated behavior of six ammonium perchlorate propellants utilizing different binder systems agree with the measured trends when only the burning rate, flame temperature, and total heat release are varied in the model from one propellant to another. Similar results are obtained when aluminum is added to one of the propellants. Author

N70-42555# Explosives Research and Development Establishment, Waltham Abbey (England).
THE BINDER/OXIDANT INTERFACE IN PLASTIC PROPELLANT
T. P. Hobin Sep. 1969 23 p refs
(ERDE-TR-10) Avail: NTIS

Contact angles between a number of organic liquids and flat, moisture-treated surfaces of ammonium perchlorate were measured. The results indicate that a moist ammonium perchlorate surface is completely wetted by hydrocarbon liquids of surface tension less than 34.5 dyn/cm, but the same surface after treatment with Surfactant S101 is completely wetted only by hydrocarbon liquids of surface tension less than 21.5 dyn/cm. The displacement of one liquid by another on the surface of ammonium perchlorate was investigated in respect of water and the various liquid ingredients of the propellant. The dependence of the physical properties of plastic propellant on the binder/oxidant interface is discussed, together with some aspects of the problem of propellant aging. Author (ESRO)

N70-42829*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BURNING OF SOLID ALUMINUM AND MAGNESIUM SPHERES IN HIGH-TEMPERATURE AND HIGH-VELOCITY GASES
Robert D. Ingebo Washington Oct. 1970 23 p refs
(NASA-TN-D-6045; E-5719) Avail: NTIS CSCL 21I

The burning of solid aluminum and magnesium spheres in high temperature and high velocity gases, produced by the

combustion of hydrogen and oxygen, was investigated experimentally. A range of combustion gas stream velocities (6600 to 25,400 cm/sec), temperatures (1545 to 3198 C), and pressures (13.6 to 18.4 atm) gave total burning times ranging from 125 to 355 msec. The time required to heat the surface of the sphere to the melting point was approximately one-half as long as the total burning time. Burning times were correlated with calculated values using a model based on a heat balance at the surface of the solid. Author

N70-42923# Naval Ordnance Lab., White Oak, Md.
COMPARISON OF CURVATURE OF DETONATION FRONT IN AP WITH THAT FOUND IN SOME CONVENTIONAL EXPLOSIVES
John O. Erkman and Donna Price 25 May 1970 57 p refs
(AD-709917; NOLTR-69-235) Avail: NTIS CSCL 19/4

The original purpose of this work was to obtain data necessary for the design of experiments in which particle velocity (u) could be measured by a new electromagnetic method. It was soon apparent that a knowledge of the curvature of the detonation front was needed for the measurement of detonation velocity as well as for u. Hence, a study was made of 50-51 mm diameter charges of AP, NQ, TNT, and RDX to provide the necessary data. The most important result of the work is the finding that the detonation front acquires a constant curvature after a fairly short run in AP charges and also in some low density conventional explosives. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N70-41818* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD OF MAKING A REGENERATIVELY COOLED COMBUSTION CHAMBER Patent
Edward F. Baehr, inventor (to NASA) Issued 22 May 1962 (Filed 15 Sep. 1959) 5 p Cl. 29-157.3 Continuation-in-part of US Patent Appl. SN 785990, Filed 9 Jan. 1959
(NASA-Case-XLE-00150; US-Patent-3,035,333; US-Patent-Appl-SN-843032) Avail: US Patent Office CSCL 21B

A lightweight combustion chamber of channel construction is described in which the coolant passages can be tailored to the exact cooling requirements of the unit during fabrication. The light gage inner walls are capable of withstanding very high heat flux rates and yet able to withstand high coolant pressures. Variations in the velocity of the cooling agent at various longitudinal stations along the chamber are furnished to provide differential cooling of the chamber wall. P.A.B.

N70-41850*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A GOVERNING ELECTRONIC MECHANISM OF THE ION PROPULSION ENGINE
Francisc C. Schwartz [1970] 19 p refs Presented at the 8th Elec. Propulsion Conf., Stanford, Calif, 31 Aug.-2 Sep. 1970; sponsored by AIAA
(NASA-TM-X-52884) Avail: NTIS CSCL 21C

The ruggedness of an electronic mechanism that transforms, controls, and coordinates the electric power for the individual functions of an electric ion propulsion engine is related to the stresses imposed on its semiconductor switching components. Causes and nature of these stresses in transistors and thyristors operating within conventional and unorthodox systems are discussed. A system is described which allows the use of highly stress tolerant switching components and yet minimizes these stresses under static and dynamic conditions of operation. Experimental results of integration of a 95% efficient, single module, 2 kW electronic converter with a 20 cm ion propulsion engine are presented. Author

N70-41876*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EROSION OF A THREE-STAGE POTASSIUM TURBINE
G. M. Kaplan and E. Schnetzer (GE, Cincinnati) [1970] 22 p refs Presented at the 5th Intersoc. Energy Conversion Eng. Conf., Las Vegas, Nev., 21-24 Sep. 1970; sponsored by AIAA
(NASA-TM-X-52888) Avail: NTIS CSCL 21E

A 5000-hour endurance test with a three-stage turbine produced a vapor exit quality of about 87 percent, comparable to current nuclear steam plant practice. Turbine rotor blade overall damage was small and indicated a potential life many times the actual 5000 hours of testing. The third-stage inlet vapor quality during the initial 4300 hours of testing was 93 percent or less (91 percent) and the exit quality was 87 percent or less for the same period. The Rene' 77 third-stage rotor blades experienced an average weight loss of 0.046 gram corresponding to a volume loss of 0.005 cu cm. Material removal occurred only at the leading edge. The maximum removal noted was approximately 2 mils near the dovetail platform extending to about 11 mils near the top of the leading edge to about 27 mils within the last 1 percent of the airfoil height. Impact damage is visible at the blade tip. Author

N70-41907*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIAL INFLOW TURBINE PERFORMANCE WITH AN EXIT DIFFUSER DESIGNED FOR LINEAR STATIC PRESSURE VARIATION
Harold E. Rohlik, Milton G. Kofskey, and William J. Nusbaum Sep. 1970 19 p refs
(NASA-TM-X-52890) Avail: NTIS CSCL 21E

Two diffusers were designed with the same area ratio but different variations between the inlet and exit. The first, with a cylindrical inner body and conical outer wall provided a rapid rise in static pressure at the inlet. The second diffuser was designed for a linear increase in static pressure from inlet to exit. Each diffuser was tested as part of the turbine with cold argon at design Reynolds number. Overall turbine total-to-total efficiency was increased from 0.894 to 0.905 in changing from the conical diffuser to the linear static pressure diffuser. The diffuser loss was reduced from 0.019 to 0.008 in terms of overall total-to-total turbine efficiency. Author

N70-41917*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE DATA FOR A SMALL LOW-SPECIFIC-SPEED TEN STAGE TURBINE TESTED IN ARGON
Michael R. Vanco Sep. 1970 16 p refs
(NASA-TM-X-52892) Avail: NTIS CSCL 21E

A turbine with low flow rate and high expansion ratio requirements, such as would be applicable to a SNAP-8 space power system, was designed and tested. The design incorporated the features necessary to provide high efficiency for this type of application. Performance data in argon are presented over a range of turbine pressure ratios from 6 to 28 and speeds ranging from 60 to 110 percent of equivalent design speed. Author

N70-41922* Hughes Aircraft Co., Los Angeles, Calif.
DOUBLE OPTIC SYSTEM FOR ION ENGINE Patent
Robert L. Zimmerman, inventor (to NASA) Issued 21 Feb. 1967 (Filed 4 Aug. 1965) 6 p Cl. 60-202 Sponsored by NASA

(NASA-Case-XNP-02839; US-Patent-3,304,718; US-Patent-Appl-SN-477333) Avail: US Patent Office CSCL 21C

The construction of the accel and focus electrodes is described which reduces spurious ion bombardment and thus increases the efficiency of the ion engine. A portion of the accel electrode, facing the focus electrode, is removed. The construction acts as a second optic system, directing the spurious ions to pass through the accel electrode rather than to impinge on it, and thereby adding their thrust to main propulsion system. The focus electrode is provided with a concave shape which directs the spurious ions toward the opening in the accel electrode or into the main ion stream. N.E.N.

N70-41967* National Aeronautics and Space Administration. Langley Research Center, Langely Station, Va.

SELF-SEALING, UNBONDED, ROCKET MOTOR NOZZLE CLOSURE Patent

Robert L. Gungle, inventor (to NASA) Issued 21 Feb. 1967 (Filed 21 Apr. 1965) 6 p Cl. 102-49

(NASA-Case-XLA-02651; US-Patent-3,304,865; US-Patent-Appl-SN-449901) Avail: US Patent Office CSCL 21H

A molded rocket closure member, which is pliable and which conforms to the general configuration of the nozzle, is described. The closure member is capable of receiving a flexible diaphragm and snap ring which expand the closure member to engage the nozzle. The nozzle closure aids ignition of the rocket motor by retaining hot gases within the chamber to a predetermined pressure and also prevents foreign objects or materials from entering the rocket chamber during ground handling or storage. R.B.

N70-41975*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TESTS OF A FULL-SCALE ANNULAR RAM-INDUCTION COMBUSTOR FOR A MACH 3 CRUISE TURBOJET ENGINE

Jerrold D. Wear, Porter J. Perkins, and Donald F. Schultz Washington Oct. 1970 46 p refs

(NASA-TN-D-6041; E-5260) Avail: NTIS CSCL 21E

A 40 in. (1.02 m) diameter primary combustor 30 in. (0.76 m) long operated for 325 hours at simulated supersonic flight conditions with no loss in performance. Tests in a component facility were at inlet-air conditions of (1)1150 F (894 K) and 90 psia (62.0 N/sq cm) (Mach 3.0), and (2) 1050 F (839 K) and 60 psia (4.14 N/sq cm) (Mach 2.7), with 2200 F (1478 K) exit temperatures. Some metal burning occurred. At Mach 3.0 conditions, combustion efficiency was 100 percent, pressure loss 7.4 percent, and exit temperature profiles good. Exit temperature pattern factors were 0.19 and 0.29 at Mach 3 and a simulated takeoff, respectively. These performance parameters (as well as altitude relight limits, heat flux, headplate temperatures, response to rapid increase in fuel flow, and exhaust smoke) were measured over a wide range of operating conditions. Author

N70-41992* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SMALL ROCKET ENGINE Patent

William T. Latto, Jr., inventor (to NASA) Issued 30 May 1967 (Filed 29 Oct. 1964) 5 p Cl. 60-260

(NASA-Case-XLE-00685; US-Patent-3,321,922; US-Patent-Appl-SN-407595) Avail: US Patent Office CSCL 21H

A method is described for cooling the combustion chamber of a small rocket engine having a restart capability, using noncryogenic hypergolic propellants. Regenerative cooling passages are contained in a high strength shell enclosing a refractory metal liner with an insulating liner between the outer shell and the inner liner. An accumulator is provided for receiving propellant from the cooling system by interrupting the propellant flow, after which the propellant continues to flow in the cooling system. The propellant in the accumulator is used when the engine is restarted. R.B.

N70-42010*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF VARIABLE TURBINE AREA ON SUBSONIC CRUISE PERFORMANCE OF TURBOJETS DESIGNED FOR SUPERSONIC APPLICATION

Arvid L. Keith, Jr. Washington Oct. 1970 64 p refs

(NASA-TN-D-5962; L-7260) Avail: NTIS CSCL 21E

The specific net thrust and specific fuel consumption of simplified turbojet engine cycles were calculated for a wide range of design compressor pressure ratio (4 to 30) and design turbine-entrance temperature (2260 R (1255 K) to 3460 R (1922 K) through a Mach number range from 0 to 3.6. Partial-power performance for engines with both fixed and variable turbine area was determined for Mach numbers from 0 to 1.0. High-pressure-ratio compressors provided significant improvements in specific fuel consumption throughout the Mach number range; however, important losses in specifid thrust occurred at the higher speeds. Turbine area reductions of up to 40 percent resulted in improvements in partial power minimum specific fuel consumptions of from 10 to 45 percent at subsonic speeds. Author

N70-42174*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL HEAT TRANSFER AND FLOW RESULTS FROM AN AIR-COOLED PLUG NOZZLE SYSTEM

John S. Clark, Edwin J. Graber, and David M. Straight Sep. 1970 63 p refs

(NASA-TM-X-52897) Avail: NTIS CSCL 21H

An air-cooled plug type nozzle system was built and tested on an afterburning turbojet engine. Three and one-half percent of the engine primary airflow, taken from the compressor discharge ports, was used to cool the plug and supporting struts. Exhaust gas temperatures up to 3350 R (1860 K) were successfully run. Extrapolation of the wall temperature data to the average design hot gas temperature of 3500 R (1945 K) indicates that maximum wall temperatures could be maintained below about 2040 R (1133 K). Author

N70-42199*# Thiokol Chemical Corp., Brigham City, Utah.

THRUST VECTOR CONTROL STUDY FOR LARGE (280 INCH) ROCKET MOTOR APPLICATIONS

Thomas L. Nickens, John L. Sutton, Lionel H. Erickson, and Philip C. Sottosanti Apr. 1970 25 p refs Presented at the JANNAF Interagency Propulsion Comm. 26th Solid Propulsion Meeting, Washington, D.C., 14-16 Jul. 1970

(Contract NAS3-12049)

(NASA-CR-114223) Avail: NTIS CSCL 21H

A study program was completed which compared three types of thrust vector control (TVC) design concepts for application on a 260 in. diameter solid rocket motor. The three TVC design concepts were: (1) mechanical interference, (2) secondary liquid injection (LITVC), and (3) movable (flexible bearing) nozzle. The comparison was made on weight, cost, simplicity, and development risk. During the preliminary design phase, mechanical interference TVC design approaches were eliminated from further contention. Preliminary system designs were prepared for LITVC and flexible bearing nozzle TVC concepts; a tradeoff comparison was performed and a single detail design made for each of these two TVC concepts. The major components of the selected LITVC system consisted of a single toroidal tank, which contained the injectant N2O4 and the pressurant GN2 and 16 equally spaced (about the nozzle circumference) electromechanical single-pintle injector valves. Two electrohydraulic servoactuators were used to vector the flexible bearing nozzle. The power source selected was a passive cold gas blowdown system using GN2 as the pressurant. Author

N70-42421*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF ROCKET-POWERED EJECTORS FOR PUMPING LIQUID OXYGEN AND LIQUID HYDROGEN

Leo C. Franciscus Washington Oct. 1970 32 p refs
(NASA-TN-D-6033; E-5414) Avail: NTIS CSCL 21H

A preliminary analysis of the use of rocket-powered ejectors for pumping liquid oxygen and liquid hydrogen in rocket engines was made. The drive gas is the exhaust gas of a smaller hydrogen-oxygen rocket engine. The analysis is one dimensional and does not include shock or friction losses. For a nominal drive rocket chamber pressure of 600 psia, ideal discharge pressures over 2500 psia for oxygen and 400 psia for hydrogen were calculated. Ejector mass ratios (ratio of oxygen or hydrogen mass flow to drive gas flow) resulting in good performance were on the order of 300 for oxygen and 200 for hydrogen. Author

N70-42437*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A 10 DEG CONICAL PLUG NOZZLE WITH A STOWED THRUST REVERSER AT MACH NUMBERS FROM 0 TO 2.0
Fred W. Steffen Washington Oct. 1, 1970 refs
(NASA-TM-X-2116) Avail: NTIS CSCL 21H

Nozzles with two throat areas and two shroud lengths were tested. Compared to a hinged iris primary-plug nozzle without a reverser, the plug nozzle with the stowed thrust reverser had higher efficiency at subsonic cruise with the shroud retracted but lower efficiency at higher pressure ratios with the shroud either retracted or extended. The stowed thrust reverser restricted corrected secondary-weight-flow ratio available from the free stream to 0.02 between Mach numbers of 0.4 and 1.1. Author

N70-42438*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF CONVERGENT AND PLUG NOZZLES AT MACH NUMBERS FROM 0 TO 1.97
Douglas E. Harrington Washington Oct. 1970 36 p refs
(NASA-TM-X-2112) Avail: NTIS CSCL 21H

A parametric variation of projected boattail area and plug area was conducted to determine the effect on performance characteristics. A convergent nozzle with a circular arc boattail and a jet to nacelle area ratio of 0.25 had an efficiency of 98.2 percent at a subsonic cruise Mach number of 0.90 and a nozzle pressure ratio of 2.8. At the same conditions, a plug nozzle with a circular arc boattail and a small plug had an efficiency of 97.3 percent, while a large-plug nozzle without a boattail was 93.9 percent efficient. Author

N70-42499# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.
THEORETICAL INVESTIGATIONS ON LOW PRESSURE HALL ACCELERATORS [ZUR THEORIE DES NIEDERDRUCK-HALLBESCHLEUNIGERS]
Konrad Schreitmueller May 1970 64 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-17) Avail: NTIS; ZLDI Munich: 16,90 DM

The carrier motion within a low pressure Hall accelerator (Hall ion thrustor) is described by means of the single particle model. The accelerator losses are mainly due to the ion deflection in the magnetic field and to the axial electron diffusion. A high efficiency is only possible if plasma instabilities can be avoided. The attainable efficiencies of a Hall thrustor and of an ion thrustor differ at optimum conditions by only a few per cent. Author (ESRO)

N70-42521*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TECHNOLOGY PROBLEMS ANTICIPATED IN THE APPLICATION OF FUSION REACTORS TO SPACE PROPULSION AND POWER GENERATION
J. Reece Roth, Warren D. Rayle, and John Reinmann Washington Oct. 1970 30 p refs
(NASA-TM-X-2106; E-5575) Avail: NTIS CSCL 21F

Some methods by which fusion reactors may be applied to space missions are discussed. The problems posed by conversion of the thermal energy of the reacting plasma to electrical power and/or to an exhaust jet are considered, and their implications for research and development in the 1970's are examined. Recent analytical and experimental studies are reviewed, and their significance for the future direction of space-related fusion research are discussed. Author

N70-42695# Rocket Propulsion Establishment, Westcott (England).
A NUMERICAL APPRAISAL OF THREE THEORETICAL DESCRIPTIONS OF TRANSONIC FLOW BY MEANS OF SERIAL EXPANSIONS
H. Treutler Dec. 1969 24 p refs
(RPE-TR-69/11) Avail: NTIS

The three series which have been suggested for representing the transition of the transonic flow second order differential equation from the elliptic to the hyperbolic form, were studied. It is concluded that Martensen's series may be used if the radius of curvature of the throat wall is larger than four times the radius of the nozzle throat. Hopkins and Hill's series may be trusted down to a radius of curvature equal to the throat radius, if sufficient terms are taken into account. Hall's series are not recommended. Author (ESRO)

N70-43057# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TEMPERATURE FIELD OF A TURBINE BLADE WITH TRANSVERSE AIR COOLING
I. S. Lyubchenko 20 Aug. 1969 10 p refs Transl. into ENGLISH from Tr. Kazansk. Aviats. Inst. (Kazan), no. 89, 1965 p 126-131
(AD-700582; FTD-HT-23-313-69) Avail: NTIS CSCL 21S

The cross section of a turbine blade with a deflector in a uniform gas flow is examined. The cooling air, entering near the root section within the deflector, passes through the slits at the leading edge of the deflector. It then breaks into branches and flows through transverse channels over concave and convex surfaces. Air consumption for cooling the back edge and trough is noted along the blade length. The stagnation temperature of the gas in the boundary layer over the profile and the blade temperature over the wall thickness are considered. The balance equations for a blade element and the air flowing past the element are equated. TAB

N70-43134*# Hughes Research Labs., Malibu, Calif.
LM CATHODE THRUSTER SYSTEM, SUPPLEMENT Final Report, 18 Jul. 1969 - 18 Jul. 1970
15 Oct. 1970 92 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952131)
(NASA-CR-110895) Avail: NTIS CSCL 21C

A 20 cm LM cathode thruster system has been developed for operation at beam currents of 0.5 A to 1.0 A and a beam voltage less than or equal to 2 kV. At the maximum beam level, the total source energy is equal to 315 eV/ion at a mass utilization efficiency of 89%. Discharge chamber performance is essentially unchanged for operation at a reduced beam voltage equal to 1 kV. The thruster employs a conventional thin-screen (0.76 cm thick), high-transparency (70%) ion-extraction system and an LM cathode which is thermally integrated with the thruster body. A mercury feed subassembly is joined to the thruster (within a common ground screen shroud) which consists of an electromagnetic pump, a liquid mercury flowmeter, and a high voltage isolator. The pump generates a pressure of 0.6 atm with a power of 2 W, and the flowmeter shows promist of a measurement accuracy of + or -1%. At full rated power, the LM cathode operates at an equilibrium temperature <200 C. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N70-41804*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE He I LINE PROFILES IN NORMAL B TYPE SPECTRA
David S. Leckrone Sep. 1970 72 p refs Submitted for publication
(NASA-TM-X-65358; X-671-70-367) Avail: NTIS CSCL 03B

An effort is described to determine to what extent the profiles of a large number of He I lines can be matched by theoretical profiles computed in local thermodynamic equilibrium (LTE). Detailed profile analyses of as many as 11 He I lines, carried out for the stars 134 Tau (B9 IV), pi Cet (B7 V), HR 2154 (B5 IV), iota Her (B3 V), gamma Peg (B2 V), HR 1861 (B1 V) and upsilon Ori (BO V), are summarized. High dispersion profile data are presented for five of these stars. Stellar surface gravity and effective temperature values are estimated from H gamma and H delta profiles and spectrophotometric data. The observed Mg II gamma 4481 profiles yield V sin i values < 30 km/sec for all the stars considered and yield an average log N(Mg)/N(H) + 12 = 7.8 + or - 0.1. Estimated He/H ratios, obtained on the basis of theoretical fits to the weaker HeI lines and to the wings of the strong lines, are given for six of the seven stars considered. An overall average N(He)/N(H) = 0.106 is obtained for these stars, from a total of 46 lines, with little scatter being noted in the results obtained from line to line for a given star. Author

N70-41817*# Michigan Univ., Ann Arbor. Dept. of Astronomy.
SOLAR SOFT X-RADIATION Final Report
Roger J. Thomas (Ph.D. Thesis) Apr. 1970 204 p refs
(Contract NAS5-3176; ORA Proj. 05567)
(NASA-CR-114113; Rept-05567-1-F) Avail: NTIS CSCL 03B

Data from the ion chamber photometer aboard the OSO-3 satellite are used to investigate relationships between solar soft X-radiation and phenomena observed at other wavelengths. X-ray fluxes are determined using the assumption of a 2,000,000 K gray-body spectrum which remains constant with time. The slowly varying component of solar soft X-radiation is shown to be closely related to the area and intensity of the Ca(+) emission of chromospheric plages. The data also suggest that the temperature of the X-ray emitting source is influenced by variations in the general level of solar activity. The burst component of soft X-radiation is examined for 283 events that are associated with well-verified H alpha flares of importance equal to or greater than 1. The properties of the general time profiles for flare-associated bursts, as well as their frequency of occurrence from center to limb, indicate that such bursts are predominantly thermal in nature. The peak enhancements in the soft X-ray and H alpha emission rates are compared. Author

N70-41836 Washington Univ., Seattle.
A STUDY OF COSMIC RAY MUONS AT DEPTHS LESS THAN 1000 FEET UNDERWATER IN LAKE CHELAN, WASHINGTON
John Gregory Learned (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-18297

An experiment was conducted underwater to study the depth and angular variations of the cosmic ray muon flux at depths of 0 to 1000 ft, and from uplooking to downlooking in angle. The data accumulated during 1967 using a Cerenkov scintillation counter telescope are consistent with current theory and equivalent measurements under rock. Some data on muons pairs were also acquired and agree with expectations from extensive air shower results. While demonstrating the feasibility of detecting particles by their Cerenkov radiation in lake water, the experiment indicates further underwater research at greater depths and on a large scale. Dissert. Abstr.

N70-41843*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ACCELERATION AND PROPAGATION OF SOLAR COSMIC RAYS AS DEDUCED FROM THE RELATIVE ABUNDANCE OF PROTONS TO HELIUM NUCLEI
Kunitomo Sakurai Sep. 1970 19 p refs Submitted for publication
(NASA-TM-X-65365- X-693-70-364) Avail: NTIS CSCL 03B

It was determined that the chemical composition of solar cosmic rays is very similar to the abundance of the elements at the photosphere of the sun, except for protons. In considering the relative abundance ratio of protons to alpha-particles (P/alpha) at constant rigidity, the ratio is highly variable from one solar cosmic ray event to another. This ratio observed at the earth, however, decreases monotonically with time from the onset of solar flares and is dependent on the heliocentric distance of the parent flares from the central meridian of the solar disk. The P/alpha's measured before the onset of SC geomagnetic storms change from 1.5 to 50 or more, being a function of the westward position of the source from the east limb of the sun. The chemical composition and rigidity spectra of solar cosmic rays suggest that solar cosmic rays are mainly accelerated by the Fermi mechanism in solar flares. The observed variation of P/alpha's is produced mainly through the difference between the propagation characteristics of protons and alpha-particles. Author

N70-41847 Arizona Univ., Tucson.
A SEARCH FOR FRACTIONALLY CHARGED PARTICLES IN COSMIC RAYS
Edmund Philip Krider (Ph.D. Thesis) 1969 39 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18328

A scintillation counter telescope consisting of six scintillation counters and four wide-gap spark chambers was arranged to detect single particles with charge + or - e/3 or + or - 2e/3 which might be present in the cosmic radiation near sea level. Upper limits to the vertical intensities of such particles are 6.8 × 10 to the minus 11th power/sq cm sec sr for charge + or - e/3 and 1.2 × 10 to the minus 10th power/sq cm sec sr for charge + or - 2e/3 at at a 90% confidence level. Dissert. Abstr.

N70-41875*# Scientific Translation Service, Santa Barbara, Calif.
SOME RESULTS OF COLOR OBSERVATIONS OF THE IC 2118 NEBULA [NEKOTORYE REZULTATY TSVETOVYKH NABLIUDENII TUMANNOSTI IC 2118]
Sh. N. Sabitov Washington NASA Jul. 1970 12 p refs Transl. into ENGLISH from Tr. Akad. Nauk Kazakhsk. SSR, Astrofiz. Inst., Issled. Tumannostey i Mezhzvezdnoy Sredy (Alma-Ata), v. 11, 1968 p 79 - 86
(Contract NASw-2035)
(NASA-TT-F-13107) Avail: NTIS CSCL 03B

An investigation was made of the luminosity of the IC 2118 nebula on the basis of polarimetric and photometric observations. It is shown that the luminosity can be explained by light scattering at dielectric particles with a mean radius of .000013 cm, however, the color properties of the nebula do not lend themselves to description in these terms. The optical thickness of the nebula increases with the wavelength. The luminosity of the nebula increases somewhat near the hydrogen line. Author

N70-41896*# Lockheed Missiles and Space Co., Palo Alto, Calif. Space Sciences Lab.
LOCKHEED EXPERIMENT ON ATS-5 Quarterly Report, 1 Jun.–31 Aug. 1970
R. D. Sharp 31 Aug. 1970 31 p refs
(Contract NAS5-10392)
(NASA-CR-114108; QR-4) Avail: NTIS CSCL 03B

The experiment on ATS-5 has been operating successfully for over a year and is continuing to provide much useful information on the low-energy (auroral) particle environment at synchronous altitude. One prominent feature of the data is an energy dependent time dispersion observed in the onset of the electron flux enhancements during magnetospheric substorms. A method is described for inferring plasma sheet convection velocities from these observations. Author

N70-41910 Rice Univ., Houston, Tex.
STRUCTURE OF THE DAYSIDE EQUATORIAL MAGNETOSPHERIC BOUNDARY AS DEDUCED FROM PLASMA FLOW
Carlos Scott Warren (Ph.D. Thesis) 1969 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-19337

On January 13 and 14, 1967, during an intense magnetic storm, anisotropic fluxes were detected by the Rice suprathermal ion detector for several hours beginning at appriximately 1300 local time. The detector is onboard the geostationary satellite ATS-1 that is located at 6.6 earth radii. It was established that the varied magnetic fields and plasma flow observed at the satellite were due to a compression of the magnetospheric boundary to the ATS-1 orbit. During the time of the compression, plasma data were recorded inside the magnetosphere, the magnetosheath, and inside the magnetospheric boundary itself. The data generally support the view that a convective-type interaction exists between the magnetosheath plasma and the magnetospheric plasma. Just inside the boundary region, where the maximum interaction is expected, ion flow characteristics are similar to those in the magnetosheath. Dissert. Abstr.

N70-41915*# Scientific Translation Service, Santa Barbara, Calif.
THE CATALOGUE OF REFLECTION NEBULAE [KATALOG OTRAZHATELNYKH TUMANNOSTEY]
D. A. Rozhkovskiy et al Washington NASA Jul. 1970 57 p refs Transl. into ENGLISH from Tr. Akad. Nauk Kazakhsk. SSR, Astrofiz. Inst., Issled. Tumannostey i Mezhzvezdnoy Sredy (Alma-Ata), v. 11, 1968 p 3–42
(Contract NASw-2035)
(NASA-TT-F-13104) Avail: NTIS CSCL 03B

The catalog includes 118 reflecting nebulae, for which values of the flux and dimensions are determined. The data on illuminating stars include the star magnitudes and spectral classes. On the basis of the observational material, some correlations between the brightness of illuminating stars and the flux from the nebula were investigated. It is shown that for all the totality of objects they can approximate the spherical nebulae. The structure of nebulae and their connection with surrounding stars are considered. It is noted that many reflecting nebulae are connected with dark clouds. It is noted that the majority of nebulae are the members of groups or associations of stars from groupings or complexes. Author

N70-41953*# New Mexico Inst. of Mining and Technology, Socorro.
AUTOMATED SOLAR SEEING MEASUREMENTS Final Report
Stirling A. Colgate and Elliott P. Moore 11 Aug. 1970 107 p refs
(Contract NAS5-11215)
(NASA-CR-114109) Avail: NTIS CSCL 03B

A series of continuous measurements of solar seeing was undertaken along the ridge just south of the summit of the Magdalena Moutains west of Socorro in New Mexico. An automation method was used which includes absolute angular calibration of the photo-electronic fluctuations. The ac component of the sum of the optical signal through each of two slits on opposite limbs of the solar image was used to monitor the solar seeing. The telescope was mounted both on a 30-foot tower and on the ground in the woods at the southern end of the ridge and on the ground at a saddle just (200 feet) below the summit peak. Within the statistical fluctuations, all three sites gave roughly the same results with negligible deterioration as a function of time during the day. Good correlation was observed between the electronic signal and human visual estimate of the quality of the seeing, although the electronic signal, in general, showed 1/3 the temporal fluctuation corresponding to the total visual defocusing. The peak of the fluctuating spectrum occurred in the band 1 to 10 Hz. Author

N70-42157*# Michigan Univ., Ann Arbor. Dept. of Astronomy.
OSO SATELLITE Final Report
Richard G. Tesre May 1970 122 p refs
(Contract NAS5-3176; ORA Proj. 05567)
(NASA-CR-114110; Rept-05567-2-F) Avail: NTIS CSCL 03B

Solar X-rays from 8–12 A were observed with an ion chamber photometer and fluxes derived from the observations after an assumption concerning the spectral distribution. The time variation of the X-ray flux correlates well with the radio flux, plage index, and sunspot number, and comparisons of X-ray and optical events are given. Flares seem to produce soft X-rays, but some soft X-ray bursts are apparently not associated with flares. The total energy involved in the soft X-ray bursts may be a significant amount of the total flare radiation. Author

N70-42245*# TRW Systems, Redondo Beach, Calif.
SOLAR ECLIPSE EXPERIMENT STUDY Final Report
W. Bernstein 10 Sep. 1970 21 p refs
(Contract NASw-2004)
(NASA-CR-110772; TRW-13833-6006-R0-00) Avail: NTIS CSCL 03B

A Javelin rocket payload for measurement of energetic hydrogen atoms at 800 km altitude was developed. This payload was launched during the solar eclipse of 7 March 1970. Analysis of the data collected indicates the presence of very large fluxes of these particles. The experiment is described together with brief consideration of the physical significance of these observations. The second phase of this program included the partial fabrication of a rocket payload for auroral measurements and laboratory testing of an electrostatic analyzer for energetic negative hydrogen ions. A total of 24 discriminators, 4 low voltage power supplies, 4 channeltron high voltage supplies, and 3 high voltage power supplies for the electrostatic analyzers was fabricated and tested. Laboratory tests of the energetic negative hydrogen ion energy analyzer show that the technique is adequate for the detection of these particles produced during the aurora. Author

N70-42336# Air Force Cambridge Research Labs., Bedford, Mass. Ionispheric Research Lab.
MICROWAVE SPECTRAL OBSERVATIONS OF CORONAL CONDENSATIONS
Ronald M. Straka Apr. 1970 31 p refs Environ. Res. Papers No. 319
(AD-709355; AFCRL-70-0241) Avail: NTIS CSCL 3/2

Radio coronal condensations during the 20 May 1966 and 12 November 1966 solar eclipses were measured by AFCRL at wavelengths of 3.4, 6.0, 11.1 and 21.2 cm. Almost all condensation regions showed peak flux values lower than 10 to the (-21)st power w/sq m/Hz. The flux spectra increased very slightly with increasing frequency, suggesting that thermal bremsstrahlung was the dominant emission mechanism. Only one source had a spectrum where gyromagnetic emission became dominant and caused peaking

near the 6.0-cm wavelength. This source was associated with the strong bipolar spot group in McMath plage region 8573 of 12 November. A quiet-sun model that was developed to determine the source flux accounted for the east-west asymmetry, limb brightening, and polar darkening in the radio brightness distribution of the background sun. The angular size of sources was smallest, with least variations, at the 6.0-cm wavelength. Brightness temperatures of the condensations were measured at 4,700,000 degrees K (21.2 cm) during both eclipses. Flares, radio bursts, and other electromagnetic emissions originating in coronal condensation regions can cause false signatures on surveillance radars, affect satellite orbit parameters, and create ionospheric disturbances that degrade communications. Knowledge of the condensation region development is needed for early warning and prediction of potential solar disturbances. Author (TAB)

N70-42423# Milan Univ. (Italy). Ist. di Scienze Fisiche.
EVALUATION AND SIMULATION OF THE PHOTON HAZARD ON A SCINTILLATION COUNTER FLOWN ON A POLAR ORBITING LOW-ALTITUDE SATELLITE
G. F. Bignami Paris ESRO Apr. 1970 27 p refs
(ESRO-SN-110) Avail: NTIS

The particle environment of the ESRO TD-1 satellite, which will have a circular, nearly polar, low-altitude orbit, is analyzed. The solar gamma ray experiment will have an anticoincidence shielding consisting of a plastic scintillator and the effects of the particle flux on it are analyzed. The orbital dose was calculated with a computer program which integrates the fluxes along an orbit given in the form of B,L coordinates versus time. Simulation of the orbital conditions with cyclotron radiation, and the responses of the photomultipliers under very high light fluxes, are also described. Conclusions of some interest to other experiments of a similar nature are discussed. Author (ESRO)

N70-42452# Institut d'Aeronomie Spatiale de Belgique, Brussels.
MEASUREMENT OF SOLAR RADIATION INTENSITY IN THE OPTICAL WINDOW BETWEEN 2000 AND 2200 ANGSTROM [DE METING VAN DE ZONNEINTENSITEIT IN HET OPTISCH VENSTER VAN 2000 TOT 2200 A]
D. Frimout (Ph.D. Thesis – Gent Univ.) 1970 215 p refs In DUTCH; ENGLISH summary *Its* Aeronomica Acta No. A-72-1970
Avail: NTIS

The absolute value of the solar intensity at 2000 A as well as the optical depth at a height of 40 km were investigated using balloon-borne equipment. Photometric measurements were made and the instruments and their calibration are described. The solar intensity in the optical window was determined with great accuracy and the discontinuity at 2080 A was confirmed. The equivalent temperature of the sun at 2000 A was 150 K lower than the accepted value. Absorption phenomena are also discussed. Author (ESRO)

N70-42516# Catholic Univ. of America, Washington, D.C. Dept. of Physics.
THE PRODUCTION OF LOW ENERGY MUONS BY NEUTRAL COMPONENTS OF THE COSMIC RADIATION AT SEA LEVEL Final Report
Clyde L. Cowan 31 May 1970 31 p refs
(Grant AF-AFOSR-164-67)
(AD-710278; AFOSR-70-1646TR) Avail: NTIS CSCL 4/1

An investigation of reactions at sea level produced by neutral components of the cosmic radiation which result in at least one muon of either sign and with energy lying between a few tens and a few hundreds of Mev. Reactions produced by incident neutrons (via pion production and decay) and by gamma radiation are observed and measured in the course of the work. A component of the total production process has been observed which seems to be inconsistent with either the neutron or gamma production mode. It is, apparently, strongly correlated with sidereal time and goes via the single negative muon channel only. The value of incident flux times cross section per target nucleon is about 3 x 10 to the -33rd power per second per steradian. The charge ratio negative muon/positive muon of the muons produced is about 1.15 for a 50% confidence interval obtained from 76 events collected in 2,475 hours of run time and where these 76 events include single negative pion production and in-flight decay events as well. Author (TAB)

N70-42549# Aerospace Corp., El Segundo, Calif. Lab. Operations.
RADIAL DIFFUSION OF OUTER ZONE ELECTRONS: AN EMPIRICAL APPROACH TO THIRD-INVARIANT VIOLATION, NOVEMBER 1969 – APRIL 1970
Michael Schulz, L. J. Lanzerotti, and C. G. Maclennan 31 Jul. 1970 65 p refs
(Contract F04701-70-C-0059)
(AD-710604; TR-0059(6260-20)-6; SAMSO-TR-70-277) Avail: NTIS CSCL 4/1

The near-equatorial fluxes of outer zone electrons (E>0.5 MeV and E>1.9 MeV) measured by an instrument on the satellite Explorer 15 following the geomagnetic storm of December 17-18, 1962, are used to determine the electron radial diffusion coefficients and electron-lifetimes as functions of L for selected values of the conserved first invariant mu. For each value of mu the diffusion coefficient is assumed to be time-independent and respresentable in the form D = (D sub n)(L sup n). The diffusion coefficients and lifetimes are then obtained simultaneously by requiring that the L-dependent reciprocal electron-lifetime, as determined from the Fokker-Planck equation, deviate minimally from a constant in time. Applied to the data, these few assumptions yield a value of D that is smaller by approximately a factor of ten than the value obtained recently by Newkirk and Walt in a separate analysis of 1.6-MeV electron data obtained during the same time period on another satellite. The electron-lifetimes are found to be strong functions of L, with 4-6 day lifetimes observed at the higher L-values (4.6-4.8). Author (TAB)

N70-42726*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
CONTINUAL VARIATIONS IN THE HIGH ENERGY X-RAY FLUX FROM SCO X-1
Walter H. G. Lewin, Jeffrey E. McClintock, Stanley G. Ryckman, Ian S. Glass, and William B. Smith Aug. 1970 13 p refs Sponsored in part by ONR
(Grants NGL-22-009-015; NSF GP-9365)
(NASA-CR-110898; CSR-P-70-47) Avail: NTIS CSCL 04A

Balloon X-ray observations of Sco X-1 were carried out from Australia on 20 March 1969. The intensity was found to fluctuate continually between 16h 30m and 21h 30m UT. Intensity changes of factors of two and three were observed within time intervals of one-half to one hour. Author

N70-43107# Laboratorium voor Ruimteonderzoek, Utrecht (Netherlands).
H(−) AS A MEMBER OF THE He ISO-ELECTRONIC SEQUENCE
Walter Van Rensbergen (Ph.D. Thesis – Utrecht Univ.) Utrecht Univ. Jul. 1970 77 p refs Partly in DUTCH and partly in ENGLISH
Avail: NTIS

The electron states of the negative hydrogen ion were investigated using geometrical extrapolation formulas, the screened Thomas-Fermi method for calculation of the wave functions, and spectral resonance methods. As low-level resonances can occur, and as they have a width of a few times 0.01 eV and are also asymmetrical, the diffuse interstellar lines at lambda = 4430, 4760, 4890, and 6180 are considered to arise from electron transitions in the negative hydrogen ion. ESRO

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N70-41845*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE CAPTURE OF SYNCHRONOUS ROTATION FOR THE MOON

Han-Shou Liu Sep. 1970 11 p refs Submitted for publication

(NASA-TM-X-65355; X-554-70-355) Avail: NTIS CSCL 22C

It is affirmed that the dynamic behavior of the librational motion for the moon near the synchronous spin rate cannot be covered with a single solution of an averaged equation of motion as a simple pendulum. The pitfalls of the averaging procedure in the theory of capture probability are pointed out. It is shown that the capture process of the synchronous rotation of the moon is not a probabilistic affair and that the value of the theory of capture is trapped into the pitfalls of the averaging method. Author

N70-41878 Indiana Univ., Bloomington.

THE PRE-MAIN SEQUENCE AND EARLY MAIN SEQUENCE EVOLUTION OF STARS IN THE MASS RANGE 0.06 TO 0.10 SOLAR MASS

Allen Stuart Grossman (Ph.D. Thesis) 1969 281 p

Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 69-17760

The structure of pre-main sequence evolution of stars in the mass range 0.06 to 0.10 solar mass was investigated at the composition X = 0.68, Y = 0.29, and Z = 0.03. The principle question investigated is whether a 0.1 solar mass star can stabilize itself on the main sequence at this composition. In addition the following aspects are investigated: (1) comparison of the theoretical models with the observations of stars of known mass on the lower end of the main sequence; (2) the effect of using different values of the ratio of mixing length to pressure scale height in the atmosphere calculation used to compute the surface boundary condition for the interior models; and (3) the value of the critical mass for stability on the main sequence at this composition. The calculation results show that stars of mass 0.1 and 0.8 solar mass at l/H sub p = 1 and stars of mass 0.1 and 0.85 solar mass at l/H sub p = 2 achieve stability on the hydrogen burning main sequence. It was concluded that the primary factor governing the stability of a 0.1 solar mass star on the main sequence is the chemical composition. Dissert. Abstr.

N70-41932# Chicago Univ., Ill. Inst. for Computer Research.

ICR Quarterly Report

Victor H. Yngve 1 Feb. 1970 72 p refs

(Contract AT(11-1)-614)

(COO-614-74; QR-24) Avail: NTIS

Project support activity is listed. Sections are given on: The memory of skilled actions and the transfer of adaptions in robots; discrimination in information theory; telescope vibrations; stability of a disk galaxy; reducing the rank of (A − lambda B) using the roots of a generalized characteristic polynomial. NSA

N70-41965*# Battelle Memorial Inst., Columbus, Ohio.

ESTIMATES OF FUTURE AUTOMATED SPACE MISSION MODELS FOR USE IN NASA LAUNCH VEHICLE PLANNING

D. A. Nippert and Jerry L. Pittenger 15 May 1970 375 p refs

(Contract NASw-2018)

(NASA-CR-114114; BMI-NLVP-TR-70-1) Avail: NTIS CSCL 22C

Mission models for the 1971 to 1981 period are described for use in obtaining estimates of future requirements for OSSA launch vehicles. The models were derived from consideration of NASA OSSA, overall NASA planning activities, and budget projections. The mission models discussed include the following: bioscience, lunar and planetary, physics and astronomy, and space applications. OSSA mission model characteristics, funding requirements, and OSSA launches by year are summarized in tables. F.O.S.

N70-42024*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

DISCRETE LEVELS OF BEGINNING HEIGHT OF METEORS IN STREAMS

A. F. Cook 8 Sep. 1970 30 p refs

(Grant NGR-19-015-004)

(NASA-CR-114107; SAO-Special-Rept-324) Avail: NTIS CSCL 03B

Of the 26 streams of meteors classified according to Ceplecha's discrete levels of beginning height, 13 are associated with known comets. Comet Biela produced in the Andromedids a double-peaked distribution. Apparently no known comets produce a stream of Class B. Consideration of Whipple and Stefanik's model of an icy conglomerate nucleus with radioactive heating and redistribution of ice leads to association of Ceplecha's Class C with the residue of the ice-impregnated surface of a cometary nucleus after sublimation of the ices, and the Ceplecha's Class A with the core of a cometary nucleus. Class B meteoroids are then to be associated with less dense cores of smaller cometary nuclei that have lost their surfaces and are too small to have been observed. Furthermore, the density of Class A meteoroids is so close to that of Type 1 carbonaceous chondrites as to suggest that the latter come from old cores of very large nuclei of comets. It is suggested that two inert objects that look like asteroids may yet remain from the two pieces observed at the last return of P/Comet Biela. Author

N70-42025*# Analytical Mechanics Associates, Inc., Lanham, Md.

TOWARD A UNIFIED SET OF LOW-THRUST MISSION ANALYSIS TECHNIQUES Interim Report

Jerry L. Horsewood Jan. 1969 15 p refs

(Contract NASw-1684)

(NASA-CR-114163; IR-69-1) Avail: NTIS CSCL 22C

Major problem areas facing the mission analyst are discussed, and possible approaches to the solutions of some of these problems are suggested. Also, extensions to currently available computer programs and techniques that will be required for the analysis of nonstandard missions representing potentially useful applications of electric propulsion are indicated. Author

N70-42029*# Maryland Univ., College Park.

RELATIVITY EFFECTS ON TRACKING DATA

Jean-Paul Richard 13 Feb. 1970 33 p refs

(Grant NGL-21-002-214)

(NASA-CR-114161) Avail: NTIS CSCL 03A

The purpose of this study is to formulate within the frame of general relativity the relations between the various quantities measured in tracking experiments: range, range rate and time. These results will be applied to simple cases where the differences between the general relativistic predictions and the classical predictions will be evaluated in an invariant way. The separability of the general relativistic corrections from possible alternate classical explanations will also be discussed. Emphasis will be on interplanetary experiments where the departure from a spherically symmetric gravitational field is more amenable to a relativistic treatment. Author

N70-42102*# Bellcomm, Inc., Washington, D.C.
LUNAR SURFACE TEMPERATURES FROM APOLLO 11 DATA
P. J. Hickson 5 Oct. 1970 23 p refs
(Contract NASw-417)
(NASA-CR-114228; TM-70-2015-5) Avail: NTIS CSCL 22A

A precision nickel resistance thermometer located outboard on the Apollo science experiments package returned good temperature data from the Apollo 11 lunar landing site for one and a half lunar days before the package ceased operation. The thermometer surface was vertical, faced north, and was 20 cm above the lunar surface of which it viewed an area of about 1 square meter. The result of a detailed 270-node thermal analysis of the data is a curve of lunar surface brightness temperature for sun elevation angles between 20 and 165 degrees with a standard error of + or − 4 K at lunar noon. The available data of the second lunar day reproduce those of the first day within the digitizing error of 1.6 K such that less than 3%/month dust accretion on the thermometer surface is consistent with the results. The preflight thermal data were used in the analysis, the results of which were not affected by adding up to 7% (theoretical) dust to the thermometer surface. This is consistent with negligible accumulation of dust on the thermometer during lunar module ascent. Author

N70-42107*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
THE 10 MICRON EMISSION FEATURE IN SUPERGIANTS, INTERSTELLAR DUST AND COMET BENNETT 1969i
E. P. Ney and N. J. Woolf 1970 10 p refs Presented at meeting of Am. Astron. Soc., Boulder, Colo., 9 – 12 Jun. 1970
(Grant NGL-24-005-008; Contract N00014-67-A-0113-0004)
(NASA-CR-114235; Rept-4) Avail: NTIS CSCL 03B

A broad emission feature centered at 10.5 microns was discovered in the spectra of M stars. This feature was attributed to the presence of silicates in cool optically thin circumstellar shells. It is presumed that the silicates form in the outer layers of oxygen rich stars, and that carbon is the primary material produced in carbon rich stars. A study of the Ic variable stars has revealed the emission feature in eight of the twelve objects observed. Observation of the Orion trapezium nebula has shown that the emission feature is present in interstellar dust. The infrared spectrum of this region exhibits the 10.5 micron excess superimposed on the scattered starlight. Recent observations of Comet Bennett have also revealed the presence of the emission maximum. Author

N70-42120# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE SOLAR LIGHT-ELEMENT ABUNDANCES AND PRIMEVAL HELIUM
Henri E. Mitler 28 Aug. 1970 20 p refs
(SAO-Special-Rept-323; SAO-006-115) Avail: Issuing Activity

From a comparison of recent determinations of photospheric element abundances with solar cosmic-ray measurements, the abundances of helium, carbon, nitrogen, oxygen, neon, magnesium, silicon, and sulphur in the solar surface are determined within a probable error of 12%. The abundance of iron is also determined this way, but the resulting value may be in error by a factor of 2. The abundance of helium is found to be lower than the usually accepted 10%. Using a simple model for the exchange of material between stars and the interstellar matter, we find that a reasonable value for the initial helium fraction is Y sub 0 is approximately 0.133, considerably smaller than the values generally obtained from hot big-bang models. Author

N70-42129# Smithsonian Astrophysical Observatory, Cambridge, Mass.
COLOR-MAGNITUDE DIAGRAMS FOR FIVE STELLAR ASSOCIATIONS IN THE LARGE MAGELLANIC CLOUD
Paul W. Hodge 7 Jul. 1970 34 p refs
(Grant NSF GP-7987)
(SAO-Special-Rept-319; SAO-001-114) Avail: Issuing Activity

Color-magnitude arrays for five large magellanic cloud stellar associations show the following features: conspicuous main sequences, a lack of cool supergiant members, a correlation of age with density, and a modest amount of reddening. One association contains an open cluster that is probably coincident in space, and another contains a Wolf-Rayet star that is probably a member. Three bright variable stars are also possible members. Author

N70-42131# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ABUNDANCES OF THE ELEMENTS IN SIRIUS AND MERAK
David W. Latham (Ph.D. Thesis—Harvard Univ., Aug. 1969) 19 Aug. 1970 105 p refs *Its* SAO Special Rept. No. 321
Avail: Issuing Activity

New instrumentation and techniques for measuring spectral-energy distributions and line strengths were developed and then applied to obtain the necessary observations for a model-atmosphere analysis of the abundances in Merak relative to Sirius. The spectrum observed for Sirius in the visual is predicted satisfactorily, but not perfectly, by the model atmosphere calculations. The observed ultraviolet spectrum is much dimmer than the models predict. A moderate resolution spectrometer was developed for scanning stellar continua. High-dispersion spectrograms of Merak were obtained and the spectral-energy distribution of Merak was measured with an accuracy of about 1%. A digitized microphotometer and associated computer programs were used to measure 1300 equivalent widths with accuracies of about 10 mA. Author

N70-42161*# Chicago Univ., Chicago. Enrico Fermi Inst.
CHEMICAL FRACTIONATIONS IN METEORITES, 4. ABUNDANCES OF FOURTEEN TRACE ELEMENTS IN L-CHONDRITES: IMPLICATIONS FOR COSMOTHERMOMETRY
Reid R. Keays, R. Ganapathy, and Edward Anders Jun. 1970 65 p refs Submitted for publication
(Contracts NAS9-7887; AT(11-1)-382)
(NASA-CR-114236; COO-382-98;EFI-70-30) Avail: NTIS CSCL 03B

A neutron activation procedure for Ag, Au, Bi, Br, Cd, Cs, Cu, Ga, In, Pd, Rb, Te, Tl, and Zn was developed and applied to eleven L3 to L6 and one LL3-4 chrondites. Correlations between abundance and petrologic type were found for Bi, Br, Cs, In, and Tl. These elements correlated with each other and with primordial Ar and Xe. The observed interelement correlations generally agree with calculated curves for trace element condensation from the solar nebula. It appears that most fractionations of volatile elements, including noble gases, arose in the solar nebula rather than in meteorite parent bodies. A few elements (Cs, Br, and Tl) are enriched in L3,4 chondrites above their cosmic abundance. Accretion temperatures of L-chrondrites were estimated from Bi and Tl contents. Petrologic types 3 to 6 seem to have accreted in a 100-degree interval centered on 530 K. The error quoted reflects the uncertainties in total nebular pressure and solubility of Bi and Tl in nickel-iron. Author

N70-42237# Syracuse Univ., N.Y. Dept. of Physics.
COSMOLOGY AS A SCIENCE
Peter G. Bergmann Jun. 1970 13 p refs Presented at the Ann. Meeting of the Am. Assoc. for the Advan. of Sci., Boston, 26-31 Dec. 1969
(Contract F33615-70-C-1110; Grants AF-AFOSR-789-66; AF-AFOSR-1654-69)
(AD-708489; AFOSR-70-1838TR) Avail: NTIS CSCL 3/2

In recent years observational techniques at cosmological distances have been improved so that cosmology has become an empirical science, rather than a field for unchecked speculation.

There remains the fact that its object, the whole universe, exists only once; hence one is unable to separate general features from particular aspects of the universe. This might not be a serious drawback if one were justified in the belief that presently accepted laws of nature remain valid on the cosmological scale. In the authors opinion, however, there are grounds for doubting that belief. The three arguments presented are (1) the possibility that apparent constants of nature may during cosmological times turn out to vary (Dirac); (2) the effective break-down of the principle of relativity caused by the effects of the cosmological environment on local experiments; and (3) the fact that present theory leads to field singularities at the early stages of the expanding universe, which might be a signal that currently accepted theoretical concepts are inadequate for an understanding of highly condensed matter.
Author (TAB)

N70-42316# National Academy of Sciences - National Research Council, Washington, D.C.
UNITED STATES SPACE SCIENCE PROGRAM
1970 252 p refs Presented at the 13th Meeting of COSPAR, Leningrad, May 1970
Avail: Issuing Activity

The activities in space sciences are reported to the Committee on International Relations Space Science Board. Areas discussed include: (1) international activities, (2) earth sciences, (3) lunar and planetary research, (4) astronomy, and (5) upper atmospheric physics. A bibliography of space sciences for 1969 is also included.
F.O.S.

N70-42352*# Michigan Univ., Ann Arbor. Radio Astronomy Observatory.
THE REDUCTION AND ANALYSIS OF DATA FROM THE LOW-FREQUENCY RADIO ASTRONOMY EXPERIMENT ABOARD THE OGO-4 SPACECRAFT Final Report
William H. Potter Jul. 1970 89 p refs
(Contract NAS5-3099; NGR-23-005-371)
(NASA-CR-110796; UM/RAO-70-5) Avail: NTIS CSCL 22A

The purpose of the OGO-D radio astronomy experiment was to map the brightness temperature of the sky at a frequency of 2.5 MHz, using a short monopole antenna on the spacecraft, and depending upon the ionospheric focusing effect to achieve angular resolution. The experiment operated for the life of the spacecraft, returning data from radiometers operating at 2.0 and 2.5 MHz and measurements of the complex impedance of the antenna at 2.5 MHz as the spacecraft passed up and down through the ionosphere. Radio frequency interference generated within the spacecraft makes the interpretation of the radiometer data difficult, and it appears to be impractical to extract mapping information. The antenna impedance measurements are not affected by the interference and represent a useful body of data for the study of the properties of the ionosphere and the behavior of antennas in plasma. Theoretical investigations were carried out in such fields as the behavior of antennas in plasma and the propagation of electromagnetic waves in plasma.
Author

N70-42357# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
THE MOTION OF THE LIBRATION POINTS. PART 2: MOTIONS AT FINITE DISTANCES FROM THE TRIANGULAR POINTS OF THE ELLIPTICALLY RESTRICTED THREE BODY PROBLEM [DIE BEWEGUNG DER LIBRATIONSPUNKTE. TEIL 2: BEWEGUNGEN IN DER WEITEREN UMGEBUNG DER DREIECKSPUNKTE DES ELLIPTISCHEN EINGESCHRAENKTEN DREIKOERPERPROBLEMS]
J. Tschauner and W. Fischer May 1970 33 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-27) Avail: NTIS; ZLDI Munich: 6.10 DM

The motion of an infinitesimal body at finite distances from the triangular points L sub 4, L sub 5 of the elliptic restricted three body problem is considered. The highly nonlinear differential equations of this problem contain a natural periodicity which means that only closed motions around the triangular points with periods related to the period of revolution by a rational proportion are possible. Only numerical methods of integration can be used so the determination of the initial conditions leading to a closed motion is very difficult. A simplification is proposed which uses the known closed motion in a fictitious circular case and allows successive computation of the motion in the elliptic case. Transfer of a spacecraft from a parking orbit around the earth to the triangular point L sub 4 by minimum accelerative force is computed for the unperturbed earth-moon system.
Author (ESRO)

N70-42383# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
THE MOTION OF THE LIBRATION POINTS. PART 3: THE MOTION IN THE SOLAR PERTURBED EARTH-MOON SYSTEM [DIE BEWEGUNG DER LIBRATIONSPUNKTE. TEIL 3: DIE BEWEGUNG IM SONNEGESTOERTEN ERDE-MOND-SYSTEM]
J. Tschauner and W. Fischer May 1970 29 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-28) Avail: NTIS; ZLDI Munich: 5.70 DM

The motion of a spacecraft in the earth-moon system is considered in the presence of the sun. A planar earth-moon-sun model is assumed which takes into account the motion of the earth-moon system around the sun and the rotation of the apsides of this system caused by the sun's influence. The model also permits consideration of the spacecraft motion in a rotating, pulsating coordinate system. Equations of motion, with the sun's influence appearing in the form of periodic coefficients, are derived. They show that closed periodic motions around the libration centers previously described for simplified concepts are not possible if a non-zero eccentricity of the earth-moon motion is taken into account.
Author (ESRO)

N70-42399*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BROUWER-LYDDANE ORBIT GENERATOR ROUTINE
E. A. Galbreath Sep. 1970 55 p
(NASA-TM-X-65361; X-553-70-223) Avail: NTIS CSCL 22C

A complete description of the Brouwer-Lyddane Orbit generator routine (BROWRO) which was written as a part of the Definitive Orbit Determination System (DODS) is presented. The routine accepts as input a set of Brouwer Mean elements at a specified epoch and outputs the position and velocity vectors at requested times along with intermediate data if requested. In addition to the basic Brouwer Theory, the BROWRO routine calls subroutines for computing Delta L Drag and complementary perturbations in order to allow for the inclusion of these effects on the satellite's orbit. A description of these subroutines is included.
Author

N70-42406# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
ON THE CALCULATION OF TANGENTIAL THRUST TRAJECTORIES IN CENTRAL FORCE FIELDS [UEBER DIE BERECHNUNG VON TANGENTIALSCHUBBAHNEN IN ZENTRALKRAFTFELDERN]
Hellmuth Sommer May 1970 37 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-20) Avail: NTIS; ZLDI Munich: 10.50 DM

The equations of motion of rocket vehicles in a spherosymmetric central force field with a thrust tangential to the trajectory can be integrated by quadratures introducing a generally applicable substitution for the thrust acceleration which also yields explicit expressions for the propulsion quantities. The independent

variable is the distance from the centre. The method was used to calculate transfers between circular orbits in a central force field with Newtonian potential. All trajectories of the two-parameter family have, in spite of continuous thrust, characteristic velocities only slightly higher than the theoretical optimum of the Hohmann ellipse. Author (ESRO)

N70-42482# Dudley Observatory, Albany, N.Y.
PLEIADES AND INTERSTELLAR MATTER [PLEYADY I MEZHZVEZDNAYA MATERIYA]
Yu. I. Glushkov Apr. 1970 39 p Transl. into ENGLISH from Issled. Tumannostey Mezhzvezdnoy Sredy. Tr. Astrofizicheskogo Inst., Akad. Nauk Kazakskoy SSR (USSR), v. 11, 1968 p 101-125 In ENGLISH and RUSSIAN
Avail: NTIS

Photographs of the nebulae in Pleiades obtained between 1963 and 1965 on a 50 cm meniscus telescope are analyzed. Various combinations of filters and plates encompassing the spectral interval from 360 up to 700 millimicrons were utilized. An extrafocal photograph of the core was included with each photograph of the nebulae for standardization of the surface brightness. Mean square errors for the seven selected spectral regions were determined. Curves are included characterizing the nebular surface brightness in five regions of the spectrum. Models of the dispersive medium around Merope and Maia are discussed. J.M.

N70-42483# Dudley Observatory, Albany, N.Y.
DIFFUSE GALACTIC RADIATION IN SMALL AREAS OF THE LARGE FORK OF THE MILKY WAY [DIFFUZNAYA GALAKTICHESKAYA RADIATSIYA V PLOSHCHADKAKH BOLSHOY RAZVILKI MLECHNOGO PUTI]
D. A. Rozhkovskiy et al Apr. 1970 22 p refs Transl. into ENGLISH from Issled. Tumannostey Mezhzvezdnoy Sredy. Tr. Astrofizicheskogo Inst., Akad. Nauk Kazakskoy SSR (USSR), v. 11, 1968 p 66-78 In ENGLISH and RUSSIAN
Avail: NTIS

Photometric observations of the Milky Way made in the region of the large fork located at the constellation Cygnus are described. Seven small areas which were devoid of the hydrogen emission and contained only a small number of very weak stars up to the 21st magnitude were selected. Both classical and correlation methods were used in determining excess lumination. A Schmidt camera and nebular spectrograph were used for the photographic observations. Reduction of the observations is outlined and an evaluation of the diffuse galactic light in the large fork is given. Figures of brightness and data tables are included. J.M.

N70-42502# Mons Univ. (Belgium). Dept. d'Astrophysique.
DIFFUSION IN STARS WITH CONVECTIVE ENVELOPE
A. Delcroix [1970] 9 p refs *Its* Commun. No. 15
Avail: NTIS

Diffusion phenomena in stars with important convective envelopes are discussed using multicomponent and fourth order approximation formulas. The results are compared with those obtained by two-component and first order approximation relations. It is found that diffusion is reduced by a factor in the range from 1.3 to 2. Author (ESRO)

N70-42504# Mons Univ. (Belgium). Dept. d'Astrophysique.
COMPUTED STELLAR BACKGROUND RADIATION AROUND 2800 AND 2000 A
E. Blondelot 1970 9 p ref *Its* Commun. No. 16
Avail: NTIS

An ESRO TD-1 satellite experiment will map the sky in the 1400 to 3000 A region by means of a photometer and a spectrometer. Stellar background radiation effects are discussed and it is shown that the detection of stellar signals is not limited by background radiation from faint stars, but rather by the statistical uncertainty on small signals and by parasitic light. ESRO

N70-42512*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EARTH-MOON TEST RANGE
Robert C. Wigand Jun. 1970 24 p Presented at the First Western Space Congress, Santa Maria, Calif.
(NASA-TM-Y-65316; X-834-70-239) Avail: NTIS CSCL 22A

Recent developments in technology, including the demonstrated capability to emplace and operate equipment packages on the lunar surface, have established the feasibility of an earth-moon test range. The range will investigate the characteristics of the earth's macroenvironment in cislunar space and will develop new techniques for the use of electromagnetic signals. Advantages of lunar distance in experimental control, perspective, and calibration, as well as the benefits of initiating a Range program are discussed. Author

N70-42544# Technische Hochschule Munchen (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.
TRIAL COMPUTATIONS ON THE DETERMINATION OF THE ZONAL COMPONENT OF THE EARTH'S GRAVITATIONAL FIELD FROM SATELLITE COORDINATE PERTURBATIONS [TESTRECHNUNGEN ZUR BESTIMMUNG DES ZONALEN ANTEILS DES GRAVITATIONSFELDES DER ERDE AUS KOORDINATENSTOERUNGEN VON SATELLITEN]
Christoph Reigber Jun. 1970 59 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-37) Avail: NTIS; ZLDI Munich: 12 DM

The generalized Fourier analysis of satellite coordinate perturbations for the determination of force field parameters was restigated. In order to test its applicability the method was applied to e determination of zonal harmonics by analysis of the deviations of e simulated satellite motion from an arbitrarily chosen reference orbit. Results of trial computations obtained from nominal tracking data in the form of geocentric satellite positions and from nominal tracking data perturbed by noise in the form of simulated measurement errors are presented. Author (ESRO)

N70-42545# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.
ON THE THEORY OF SPACECRAFT GUIDANCE [ZUR THEORIE DER RAUMFAHRZEUGFUEHRUNG]
R. Priebs, W. Holzapfel, T. Tseniklidis, and H.-U. Gellinger Jun. 1970 379 p refs In GERMAN; ENGLISH summary Sponsored in part by Bundesmin. fuer Bildung und Wiss. and Deut. Ges. fuer Ortung und Navigation
(BMBW-FB-W-70-31) Avail: NTIS; ZLDI Munich: 79.20 DM

The n-body, two-body, and restricted three-body problems are discussed and methods of trajectory determination are described, especially those for artificial earth satellites. The fundamental theory of rocket propelled vehicles is used for a discussion of free-flight and powered trajectories and optimization problems. Descriptions of spacecraft navigation procedures for earth satellite and interplanetary missions are also given. Author (ESRO)

N70-42580*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE GEOLOGIC EVOLUTION OF THE MOON
Paul D. Lowman, Jr. Sep. 1970 47 p refs
(NASA-TM-X-65367; X-644-70-381) Avail: NTIS CSCL 03B

Pre- and post-Apollo 11 studies are synthesized to produce an outline of geologic evolution of the moon from three lines of evidence: (1) relative ages of major lunar landforms and rock types, (2) absolute ages of returned lunar samples, and (3) petrography of lunar rocks and soils. The moon's geologic evolution is divided into four main states: Stage 1 (4.7 billion years ago): Origin of moon by unknown means, followed immediately by heating to temperatures of at least 1200 C. Old highland craters formed in last stages of origin. Stage 2 (4.6 to 3.7 billion years before present): First differentiation to form highland crust, of anorthositic, basaltic

or granitic composition; formation of circular mare basins by infall of large circumterrestrial bodies; formation of Archimedes-type craters; vulcanism in highlands. Stage 3 (3.8 to 3.4 billion years before present): Second differentiation of moon – basaltic magma generation and eruption to form maria. Stage 4 (3.4 billion years ago to present time): Sporadic impacts by asteroid belt meteoroids and comet nuclei to form ray craters, local vulcanism, tension faulting, and continual landscape degradation by small meteorite impacts and other agents. The moon now appears to be relatively inactive compared to the earth, cold and rigid to depths of at least 300 kilometers. Author

N70-42583# Mons Univ. (Belgium). Dept. d'Astrophysique.
PRINTING ERRORS AND ANOMALIES IN SOME STAR CATALOGS IN FREQUENT USE [ERREURS D'IMPRESSION ET ANOMALIES DANS QUELQUES CATALOGUES D'ETOILES FREQUEMMENT UTILISES]
L. Houziaux and J. Blondelot-Lickes [1970] 8 p refs In FRENCH *Its* Commun. No. 13
Avail: NTIS

Typing errors or anomalies found in the Henry Draper and Smithsonian Astrophysical Observatory star catalogs, etc., are listed. ESRO

N70-42588 National Lending Library for Science and Technology, Boston Spa (England).
COMPARATIVE ASSESSMENT OF COEFFICIENTS OF FRICTION BETWEEN METAL AND ROCK IN AIR AND ULTRA-HIGH VACUUM [SRAVNITELNAYA OTSENKA KOEFFITSIENTOV TRENIYA MEZHDU METALLOM I GORNYMI PORODAMI NA VOZDUKHE I V SVERKHVYSOKOM VAKUUME]
M. D. Nusinov et al Feb. 1970 5 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (USSR), v. 180, no. 5, 1968 p 1099–1100
(NLL-SMRE-Trans-5810-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The coefficients of friction between metal and rock samples were determined under simulated lunar surface vehicle conditions. The rocks used were green tuff, red tuff, white marble, serpentine, and basalt. The coefficient of marble showed a higher value in vacuum than in air; the other values were lower, and the coefficient for serpentine was markedly lower. N.E.N.

N70-42630*# Translation Consultants, Ltd., Arlington, Va.
SCIENTIFIC AND TECHNICAL EXPERIMENTS PERFORMED ABOARD SOYUZ-9 [NAUCHNYYE I TEKHNICHESKIYE EKSPERIMENTY NA BORTU SOYUZA-9]
V. I. Sevastyanov Washington NASA Oct. 1970 17 p Transl. into ENGLISH from 21st Intern. Astronautical Congr. (Constance, Moscow), 4–10 Oct. 1970 19 p
(Contract NASw-2038)
(NASA-TT-F-13380) Avail: NTIS CSCL 22A

The technical experiments and investigations made during the 18-day flight are discussed. The data include studies of near space and the earth's surface, the day, night, and twilight horizons, rare phenomena observed in the earth's atmosphere, and the national economy of the USSR. Author

N70-42638*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SOLAR CONSTANT AND THE SOLAR SPECTRUM MEASURED FROM A RESEARCH AIRCRAFT
Matthew P. Thekaekara, ed. Washington Oct. 1970 92 p refs
(NASA-TR-R-351; G-991) Avail: NTIS CSCL 03B

The solar constant and solar spectrum were measured from a research aircraft flying at 38,000 feet, above the highly variable and absorbing constituents of the atmosphere. A wide range of solar zenith angles was covered during six flights for over 14 hours. Eleven instruments, five for total irradiance and six for spectral irradiance, were employed. The instruments complemented each other in the measuring techniques employed and wavelength range covered, and were calibrated and operated by different experimenters. The combined results of these experiments are presented, and also a proposed standard for the solar constant and zero air mass solar spectral irradiance. The solar constant is found to equal 135.3 mW/sq cm or 1.940 cal/min/sq cm. Author

N70-42649# Office of Research Analyses, Holloman AFB, N.Mex.
GEODETIC APPLICATION OF LONG BASE-LINE INTERFEROMETRY Final Report
Herman O. F. Scharn May 1970 119 p refs
(AD-709868; ORA-70-0005) Avail: NTIS CSCL 8/5

Pulsars, the newly discovered celestial radio sources, can be utilized to determine the distance between two radio telescope stations on or above the surface of the earth. The accuracy in the determination of large geodetic distances achievable with this new method is investigated in two concepts: Evaluation of a large number of observations on one pulsar and evaluation of single measurements on three different pulsars. Author (TAB)

N70-42656# Osservatorio Astronomico di Roma (Italy).
SOLAR PHENOMENA
Massimo Cimino Jun. 1970 16 p *Its* Monthly Bull. No. 150
Avail: Issuing Activity

Solar data for June, 1970 are presented by the Astronomical Observatory of Rome. Tables include: (1) daily total areas of sunspot groups, (2) heliographic position, classification and area of sunspot groups, (3) longitudinal sunspot magnetic fields, and (4) hours of K-line cinematographic patrol. F.O.S.

N70-42710*# GCA Technology Div., GCA Corp., Bedford, Mass.
PLANETARY METEOROLOGY Final Report
George Ohring Aug. 1970 47 p refs
(Contract NASw-1725)
(NASA-CR-114158; GCA-TR-70-9-N) Avail: NTIS CSCL 03B

Abstracts are presented of research on the high surface temperature and the greenhouse effect on Venus, the mean vertical temperature profile of the Venusian atmosphere based on radiative equilibrium, and an infrared transmittance model for planetary atmospheres research. A theoretical estimate of the temperature climate of Venus is obtained by use of a thermal equilibrium model. A meteorological approach is used for evaluating the hypothesis that the clouds of Venus are composed of water substance. Best estimates of temperature profiles are used to obtain required saturation water vapor amounts. Actual water vapor amounts, based on information from spacecraft and earth-based observations, are then compared to the required amounts to see whether saturation is achieved. The results indicate that the water vapor observations of Venera 4, 5, and 6 support the hypothesis of water clouds. Author

N70-42713# Denver Univ., Colo. Dept. of Physics.
LUNAR SURFACE STUDIES Final Report, 17 Jan. 1969–31 May 1970
David G. Murcray Jun. 1970 36 p refs
(Contract F19628-69-C-0192)
(AD-710411; AFCRL-70-0429) Avail: NTIS CSCL 3/2

The report presents the results of a number of investigations, the common goal of which was a better understanding of the lunar surface. The studies have included measuring the infrared emissivity of selected areas of the lunar surface in the wavelength region from 7 micrometers to 14 micrometers with a balloon borne system, and laboratory studies of the effect of the lunar environment on various materials. The laboratory work has included developing the instrumentation required to subject various materials to proton fluxes similar to those the material would receive on the lunar surface, and to study the effects such a bombardment has on the

material. It has also included developing the techniques required to properly prepare powdered rock and mineral samples for the study of their optical properties. Once the techniques had been developed a number of rocks and minerals were procured and suitable powdered samples prepared. Author (TAB)

N70-42731*# California Univ., Berkeley. Space Sciences Lab.
PHOTOSPHERIC MAGNETIC FIELD ROTATION: RIGID AND DIFFERENTIAL
John M. Wilcox, Kenneth H. Schatten, Andrew S. Tanenbaum, and Robert Howard 13 Apr. 1970 20 p refs Submitted for publication *Its* Ser. 2, Issue 27
(Grant NGR-05-003-230; Contract N00014-69-A-0200-1016; Grant NSF GA-1319)
(NASA-CR-110860; AD-707746) Avail: NTIS CSCL 03B

An autocorrelation of the direction of the large-scale photospheric magnetic field observed during 1959-1967 has yielded evidence that the field structure at a given heliographic latitude can display both differential rotation and rigid rotation properties. TAB

N70-42748# Harvard Coll. Observatory, Cambridge, Mass.
HIGH-RESOLUTION K-LINE SPECTROSCOPY OF G-TYPE AND K-TYPE STARS Final Report, 1 Jan. 1969 - 30 Jun. 1970
William Liller 13 Aug. 1970 7 p
(Contract N00014-67-A-0298-0023)
(AD-710408) Avail: NTIS CSCL 3/2

The twofold aims of the report are (1) to bring to completion a high resolution echelle spectrograph mounted at the coude focus of Harvards 61-inch telescope, and (2) to use the instrument in a continuing study of the changes in the shape of the emission component in the Ca II K-line in late type stars. Both aims were achieved; Part 2 hopefully will be continued but at a substantially reduced level of operation. Author (TAB)

N70-42767# Technische Hochschule Munchen (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.
APPLICATION OF HAMMERSTEIN'S METHOD OF AN INFINITE NUMBER OF VARIABLES TO THE PROBLEMS OF SATELLITE GEODESY AND CELESTIAL MECHANICS [ANWENDUNG DER HAMMERSTEINSCHEN METHODE DER UNENDLICH VIELEN VARIABLEN AUF PROBLEME DER SATELLITENGEODAESIE UND HIMMELSMECHANIK]
Rudolf Sigl, Manfred Schneider, Christoph Reigber, and Herbert Ludwig Jun. 1970 41 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-33) Avail: NTIS; ZLDI Munich: 8,20 DM

Some satellite geodesy and celestial mechanics problems can be formulated as boundary value problems and the equivalent integral equations can be solved using Hammerstein's method. These procedures are applied to the determination of satellite orbits, field parameters and station coordinates. Author (ESRO)

N70-42793*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-64, VOLUME 2 FOR THE PERIOD 1 JUNE TO 31 JULY 1970. THE DEEP SPACE NETWORK
31 Aug. 1970 117 p refs
(Contract NAS7-100)
(NASA-CR-110839; JPL-SPS-37-64-Vol-2) Copyright. Avail: NTIS CSCL 22C

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3. ADVANCED ENGINEERING p 12-86 refs (See N70-42796 24-30)
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5. OPERATIONS AND FACILITIES p 105-108 (See N70-42798 24-30)

N70-42794*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INTRODUCTION: DESCRIPTION OF THE DSN
In its Space Programs Sum. No. 37-64, Vol. 2 31 Aug. 1970 p 1-3 ref (See N70-42793 24-30)
Copyright. Avail: NTIS CSCL 22C

The Deep Space Network (DSN) for two-way communications with unmanned spacecraft travelling approximately 10,000 miles from earth is described. The primary objective of the DSN to continue its support of planetary and interplanetary flight projects is briefly examined. To support these flight projects, the DSN simultaneously performs advanced engineering on components and systems, integrates proven equipment and methods into the network, and provides direct support of each project through tracking and data systems. The DSN operation characterized by six systems (tracking, telemetry, command, monitoring, simulation, and operations control) is also discussed. J.A.M.

N70-42795*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MISSION SUPPORT
In its Space Programs Sum. No. 37-64, Vol. 2 31 Aug. 1970 p 4-11 refs (See N70-42753 24-30)
Copyright. Avail: NTIS CSCL 22C

The Deep Space Network (DSN) support for the Mariner Mars 1971 mission is examined, as well as project requirements, DSN testing philosophy, DSN training, implementation schedules, and possible best-match solution. The IBM 360/75 phased capability is summarized for the command, tracking, telemetry, and monitor and operations control systems. The DSN support of the Apollo 13 flight is discussed, along with cancelled plans due to the aborted mission. J.A.M.

N70-42796*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED ENGINEERING
In its Space Programs Sum. No. 37-64, Vol. 2 31 Aug. 1970 p 12-86 refs (See N70-42793 24-30)
Copyright. Avail: NTIS CSCL 22C

A few aspects of advanced engineering for the Deep Space Network are reviewed. Tracking and navigational accuracy was analyzed including charged particle calibration systems analysis and an ionospheric model evaluation. The ionospheric electron content was determined from Faraday rotation measurements of an earth satellite and a deep space probe. Digital telemetry and command, digital acquisition and detection, information systems, and frequency generation and control in communications systems research were reviewed, along with tracking and data acquisition elements research. The DSS 13 operations, the planetary ranging demodulator, a 30 degree reflector mockup study, and a welded joint integrity study were also discussed. J.A.M.

N70-42797*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT AND IMPLEMENTATION
In its Space Programs Sum. No. 37-64, Vol. 2 31 Aug. 1970 p 87-104 refs (See N70-42793 24-30)
Copyright. Avail: NTIS CSCL 22C

The DSIF monitor system development, a simulation conversion assembly, impact damage modification of antenna acceleration, and DDS 51 antenna mechanical subsystems are considered. A transmitter phase modulation was found to result from beam voltage ripple. A cloc-sync antenna was installed at the U.S. Naval Observatory. J.A.M.

N70-42798*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPERATIONS AND FACILITIES
In its Space Programs Sum. No. 37-64, Vol. 2 31 Aug. 1970

p 105 – 108 (See N70-42793 24-30)
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Network allocation schedules of DSN operations are considered. The Mariner Mars 1971 mission support area was functionally specified, and the configuration was determined. The architectural and electrical designs for wall modifications and for the electrical power distribution systems with the mission support area were completed. J.A.M.

N70-42943# Institut d'Astrophysique, Paris (France).
ANALYTICAL CALCULATION OF THE EXTERNAL LAYERS OF A SUPERDENSE ZERO-TEMPERATURE STAR [CALCUL ANALYTIQUE DES COUCHES EXTERIEURES D'UNE ETOILE SUPERDENSE A TEMPERATURE NULLE]
F. Pacini ESRO Oct. 1967 11 p refs In FRENCH; ENGLISH summary
(ESRO-SN-48) Avail: NTIS

A model atmosphere was derived analytically, within the Newtonian approximation, for a superdense, zero-temperature star. The results, when applied to a typical neutron star of 10 km radius, lead to an atmosphere of 1.4 km thickness and 4 x 10 to the 23rd power g mass. Author (ESRO)

N70-42948*# National Aeronautics and Space Administration, Washington, D.C.
OAO-B (TO BE LAUNCHED NO EARLIER THAN 17 NOVEMBER 1970): PRESS KIT
29 Oct. 1970 37 p refs
(NASA-News-Release-70-174) Avail: NASA Scientific and Technical Information Division CSCL 22C

The Orbiting Astronomical Observatory - B (OAO-B) mission is summarized as well as the Atlas-Centaur launch vehicle, and launch operations. The on board telescope is described and its capabilities are outlined along with facts on the spacecraft, experiments, spacecraft tracking, contractors, launch vehicle characteristics, flight sequence, and results of previous OAO experiments. J.M.

N70-42976*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SPACE TRANSPORTATION SYSTEM TECHNOLOGY SYMPOSIUM. VOLUME 3: STRUCTURES AND MATERIALS
Jul. 1970 363 p refs Symp. held in Cleveland, 15 – 17 Jul. 1970
(NASA-TM-X-52876-Vol-3; E-5866-Vol-3) Avail: NTIS CSCL 22C

Papers are presented on structural design and analysis, thermal protection systems, and materials development and testing for space shuttles. For individual titles see N70-42977 through N70-43003.

N70-43004*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SPACE TRANSPORTATION SYSTEM TECHNOLOGY SYMPOSIUM. VOLUME 7: BIOTECHNOLOGY
Jul. 1970 123 p refs Symp. held in Cleveland, 15 -17 Jul. 1970
(NASA-TM-X-52876-Vol-7; E-5866-Vol-7) Avail: NTIS CSCL 22C

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N70-43005*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF 'ORBITAL DECONDITIONING' ON CREW/PASSENGER TOLERANCE TO ORBITER REENTRY ACCELERATION
R. W. Sullivan (PHS Hosp., San Francisco), H. C. Vykukal, K. H. Hyatt, (PHS Hosp., San Francisco), R. F. Haines, and W. R. Vetter (PHS Hosp., San Francisco) *In its* Space Transportation System Technol. Symp., Vol. 7 Jul. 1970 p 1 – 14 refs (See N70-43004 24-30)
Avail: NTIS CSCL 22C

Although previous manned space flight experience has indicated that spacecraft reentry accelerations posed no appreciable physiological or performance problem for the astronauts, the space shuttle orbiter reentries may ee be of concern, particularly if the orbiter crew and passengers are seated upright as in conventional aircraft. For this seat orientation, the orbiter reentry acceleration will result in inertial forces directed from head to foot, rather than the chest-to-back forces typical of previous manned spacecraft reentries. For orbitally deconditioned crew and passengers, orbiter reentries may result in impaired cardiovascular system function, even for the relatively low peak accelerations of about 2 to 3 G anticipated during reentry. Background information on pertinent cardiovascular physiology, results from bed rest studies and from a centrifuge study, and plans for a more comprehensive study to assess the effects of prolonged bed rest on acceleration tolerance specific to the orbiter reentry are presented and discussed. Author

N70-43038# Dudley Observatory, Albany, N.Y.
SPECTROPHOTOMETRIC STUDIES OF THE NEBULA IC 349 [SPEKTROFOTOMETRICHESKIYE ISSLEDOVANIYA TUMANNOSTI IC 349]
Z. V. Karyagina et al Apr. 1970 8 p Transl. into ENGLISH from Issled. Tumannostey Mezhvezdnoy Sredy, Tr. Astrofizicheskogo Inst., Akad. Nauk Kazakskoy SSR (USSR), v. 11, 1968 p 126 – 130 In ENGLISH and RUSSIAN
Avail: NTIS

A fast diffraction spectrograph mounted at the Newtonian focus of an AZT-8 telescope was used for spectrophotometric analysis of the IC 349 nebula. The star Merope was used to standardize the blue ray film exposures and photometry of all spectra was conducted using a microphotometer with a 0.5 mm slit. A correction for light absorption by the earth atmosphere was introduced to compensate for zenithal-distance differences between

the nebula and Meropa. The average energy distribution values in the spectrum were 10 to 15%. Spectral brightness characteristics of the nebula between 3700 to 5200 A were analyzed, and a depression in the 4100 to 4400 A region was observed. J.M.

N70-43043*# Auburn Research Foundation, Inc., Ala.
[ROTATIONAL DYNAMICS OF ARTIFICIAL SATELLITES] Technical Report, 1 Apr. 1968 – 1 Apr. 1969
1 Apr. 1969 30 p refs
(Contract NAS8-20175)
(NASA-CR-102884) Avail: NTIS CSCL 22C

Results are summarized from the application of perturbation methods of celestial mechanics to the rigid body problem with particular emphasis on the problem of the motion of an artificial earth satellite about its center of mass. The Hamiltonian was expressed for the triaxial body in terms of variables in which it is readily separable. This, permitted the introduction of a canonical transformation to new parameters which are constants in the torque free motion. The equations of transformation were then inverted to express the original Euler angles and associated conjugate momenta in terms of the canonical constants and the time. Author

N70-43073*# Boeing Co., Seattle, Wash.
DEVELOPMENT OF A SIMPLE LUNAR MODEL FOR APOLLO Final Report
R. E. Risdal 24 Apr. 1969 64 p refs
(Contract NAS1-7954)
(NASA-CR-66760; D2-100819-1) Avail: NTIS CSCL 22C

A simplified four coefficient lunar gravitational potential model was developed for Apollo mission control. This model was developed using Lunar Orbiter tracking data. It provides accurate predictions of orbit element histories over a range of orbit inclinations and orbit eccentricities. Author

N70-43079*# California Univ., Berkeley. Space Sciences Lab.
INTERPLANETARY SECTOR STRUCTURE NEAR THE MAXIMUM OF THE SUNSPOT CYCLE
John M. Wilcox and David S. Colburn (NASA. Ames Res. Center) 5 May 1970 17 p refs Submitted for publication *Its* Ser. 11, Issue 37
(Grant NGL-05-003-230; Contract N00014-69-A-0200-1016; Grant NSF GA-1319)
(NASA-CR-110861; AD-707748) Avail: NTIS CSCL 03B

The interplanetary magnetic sector structure during 1968 has been investigated. During most of the year there were two sectors per solar rotation. The sector structure remains well established despite the increased solar activity near sunspot maximu. The rotation period of the interplanetary field was 27.0 plus or minus 0.1 days. Author (TAB)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N70-41855* California Inst. of Tech., Pasadena.
ATTITUDE CONTROL FOR SPACECRAFT Patent
John C. Nicklas, James D. Acord, James O. Lonborg, and James C. Randall, inventors (to NASA) Issued 14 Feb. 1967 (Filed 11 Aug. 1964) 6 p Cl. 244-1 Sponsored by NASA
(NASA-Case-XNP-02982; US-Patent-3,304,028; US-Patent-Appl-SN-388966) Avail: US Patent Office CSCL 22B

An attitude control system for spacecraft is described in which incident solar radiation on movable control surfaces is converted into mechanical torques about the center of mass of the spacecraft. The system incorporates temperature responsive elements which alter the position of the control surfaces upon exposure to the radiant energy of the sun. The system requires no consumable energy source and may also be used as a vernier attitude control after jets or other control devices have brought the spacecraft into the approximately desired attitude. R.B.

N70-41871* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
CRYOGENIC STORAGE SYSTEM Patent
William A. Chandler and Robert R. Rice, inventors (to NASA) Issued 21 Feb. 1967 (Filed 22 Oct. 1965) 6 p Cl. 62-45
(NASA-Case-XMS-04390; US-Patent-3,304,729; US-Patent-Appl-SN-502729) Avail: US Patent Office CSCL 22B

A spacecraft system for storing gases at supercritical pressure and low temperature within a pressure vessel surrounded by subcritical cryogen is described. The cryogen is selected on the basis of low temperature boiling point, high heat sink capacity, and high sensible heat. The cryogen container completely encloses the gas pressure vessel, and in turn is surrounded by an evacuated space and a metallic shield which is an isothermal heat barrier to ambient radiant heat. The liquid cryogen evaporates slowly, and the vaporized cryogen is exhausted to avoid a pressure buildup. The venting conduit is wrapped around the cryogen container and serves as a refrigerating pipe and heat exchanger. The weight of the storage system decreases as the vaporized cryogen is exhausted, and the average weight of the system is less than the weight of conventional systems. N.E.N.

N70-41947*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DELTA PAC ATTITUDE DETERMINATION AND ERROR PREDICTION
Ai Chun Fang Sep. 1970 86 p refs
(NASA-TM-X-65351; X-732-70-338) Avail: NTIS CSCL 22B

The described project consists of both an analysis and a FORTRAN 4 program, utilized to evaluate the Delta packaged control spacecraft (Delta PAC) attitude control system after launch into a circular orbit. The analysis is described with reference to formulation of attitude determination equations, calculation of the required elements of error ellipses, and discussion of various cases arising from incomplete sensor output. In the approach developed, the complete sensor data are used to determine two independent vectors, which are applied to obtain the spacecraft attitude. The FORTRAN 4 program, written for the SDS-9300 digital computer, is included as an appendix. P.A.B.

N70-41948* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TANK CONSTRUCTION FOR SPACE VEHICLES Patent
Josef F. Blumrich and Carl A. Loy, inventors (to NASA) Issued 21 Feb. 1967 (Filed 28 Jan. 1965) 7 p Cl. 60-257
(NASA-Case-XMF-01899; US-Patent-3,304,724; US-Patent-Appl-SN-428882) Avail: US Patent Office CSCL 22B

A liquid propellant tank design is described in which a bulkhead of a semitoroidal configuration, shallower than the standard ellipsoidal bulkhead, is attached to each end of a cylindrical body. A supporting column extending through the body's center is connected at one end to the rocket engine thrust structure, to provide the load bearing means. The design increases the volume to length ratio in large diameter tanks. P.A.B.

N70-41959*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SCIENTIFIC EXPERIMENT FLEXIBLE MOUNT Patent Application

Horace E. Whitacre and Arthur R. White, inventors (to NASA) Filed 17 Aug. 1970 23 p
(NASA-Case-MSC-12372-1; US-Patent-Appl-SN-64391) Avail: NTIS CSCL 22B

An apparatus for mounting scientific experiments in a spacecraft is described which permits their utilization without maneuvering of the spacecraft. One end of an elongate flexible bellows is hermetically attached to the framework of the spacecraft in an encircling relationship about an opening. The other end is sealed over with an adaptor plate to permit interconnection of a camera, optical system, sextant, or other equipment. A gimbal system attaches the adaptor plate to the frame of the spacecraft permitting rotational movement on a pair of orthogonal axes. Drive motors or hand operated adjusting means interconnect the pair of gimbals for controlled movement of the scientific experiment. NASA

N70-42015* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TECHNIQUES FOR INSULATING CRYOGENIC FUEL CONTAINERS Patent
Liam R. Jackson, inventor (to NASA) Issued 23 May 1967 (Filed 21 May 1965) 11 p Cl. 244-135
(NASA-Case-XLA-01967; US-Patent-3,321,159; US-Patent-Appl-SN-457875) Avail: US Patent Office CSCL 22B

Purge systems associated with cryogenic fuel storage and transportation are described. The system prevents the entrance of deleterious, condensable gases into the cold spaces around the cryogenic fuel tank and also provides insulation. The fuel tank is covered with a porous insulation material with spaces between the insulation and the supporting structure into which carbon dioxide may be introduced. When the tank is filled with cryogenic fuel, the carbon dioxide solidifies and condenses in the form of carbon dioxide frost, permeating the insulation material. Upon aerodynamic heating the frost sublimates and gives off carbon dioxide gas which purges the area between the insulation and the vehicle skin, preventing entrance and condensation of atmospheric gases in the spaces between the fuel tank and vehicle skin. The purge is effective so long as the carbon dioxide gas pressure exceeds that of the external environment. R.B.

N70-42018*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIME AND FUEL OPTIMAL CONTROL FOR GRAVITY GRADIENT SPACECRAFT
F. C. Zach Sep. 1970 28 p refs Submitted for publication
(NASA-TM-X-65354; X-763-70-353) Avail: NTIS CSCL 21C

Severe constraints on the amount of fuel available in spacecraft make it necessary to develop economical policies for attitude control. A promising approach is to combine active control by means of electric propulsion devices and passive gravity gradient control. The maximum principle is used to derive a time-fuel optimal control law for gravity gradient satellites. Switching lines which make it possible to determine the optimal control for each measured set of angles and rates are derived for decoupled gravity gradient satellites. The special cases of pure time optimal and pure fuel optimal control are solved using the maximum principle. The possible extensions to coupled gravity gradient satellites are treated and it is shown that no unique switching lines can be derived. Author

N70-42030*# Goodyear Aerospace Corp., Akron, Ohio.
MATERIALS TECHNOLOGY ADVANCEMENT PROGRAM FOR EXPANDABLE MANNED SPACE STRUCTURES Summary Report
Kenneth L. Cordier and William B. Cross Aug. 1970 30 p refs
(Contract NAS1-9112)
(NASA-CR-66948; GER-14779) Avail: NTIS CSCL 22B

Existing materials technology for expandable structures was applied to full-scale models of airlocks, space station modules, and lunar shelters. The models, which successfully demonstrated design requirements for packaging, leak rates, and structural integrity, did not utilize nonflammable materials and hence were not compatible with an oxygen pressurized internal environment. The results are presented for an extensive materials screening effort and selection process, fabrication of composite materials, and qualification testing. A definition is given of construction techniques required for flight quality mission hardware. As a result of the development program, promising designs of fire-resistant composite wall structures were evolved for expandable manned space structures. Author

N70-42031*# Goodyear Aerospace Corp., Akron, Ohio.
MATERIALS TECHNOLOGY ADVANCEMENT PROGRAM FOR EXPANDABLE MANNED SPACE STRUCTURES Final Report
Kenneth L. Cordier and William B. Cross Aug. 1970 197 p refs
(Contract NAS1-9112)
(NASA-CR-66949; GER-14774) Avail: NTIS CSCL 22B

Criteria and screening tests of composite materials for use in expandable manned space structures are outlined. Materials test results including flammability, micrometeoroid impact, thermal vacuum, thermal shock, humidity, ply adhesion, and taber abrasion are summarized along with effluent gas analysis; tensile stress-strain properties; resistance to tear, puncture, and fungus; solar absorptance, and infrared emittance. Fabrication techniques are cited and the thermal control system is analyzed as well as utilized inspection and quality assurance methods. J.M.

N70-42075* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
TRANSPIRATIONALLY COOLED HEAT ABLATION SYSTEM Patent
William R. Downs, inventor (to NASA) Issued 23 May 1967 (Filed 14 Jul. 1965) 9 p Cl. 244-1
(NASA-Case-XMS-02677; US-Patent-3,321,154; US-Patent-Appl-SN-472066) Avail: US Patent Office CSCL 22B

A thermal protection system for interplanetary spacecraft reentering the earth's atmosphere is described. A heat ablative means, adapted to be secured to the leading edge of the space vehicle, contains passageways provided by drilling small holes or by a special honeycomb construction. A chamber which communicates with the passages in the ablator is pressurized with a desired cooling fluid shortly before reentry. This fluid can then be supplied through the passages to the ablator surface. The boundary layer established serves to conduct away some of the kinetically produced heat and to provide a high degree of shielding against back radiation of heat from the incandescent boundary. P.A.B.

N70-42271*# National Aeronautics and Space Administration. Washington, D.C.
SPACE SCIENCE AND APPLICATIONS Fact Sheet on NASA's Program
Oct. 1970 22 p
(NASA-TM-X-66371) Avail: NTIS CSCL 22A

Fact sheets are presented on individual unmanned programs. Description of the spacecraft, objects of the flight, schedule, program officials, funding, and prime contractor are listed for each program. N.E.N.

N70-42330*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEPLOYABLE SUPPORT Patent Application
Herman P. Valentijn, inventor (to NASA) Filed 8 Apr. 1970 36 p
(Contract NAS7-100)
(NASA-Case-NPO-10883; US-Patent-Appl-SN-26573) Avail: NTIS CSCL 13M

A deployable support is described which is particularly suited for use in operatively supporting arrays of solar cells aboard spacecraft. The support is characterized by a plurality of independent modules, each including a panel formed of a plurality of trapezoidal panel segments and articulated track segments. These are adapted

to be stowed in a folded configuration and subsequently deployed into a laterally extended and substantially continuous surface. A particular feature of the support is an inclusion of cantilever structure which accommodates deployment of panels of solar cells in a continuous harmonic sequence. The normally attendant transient loading of spacecraft during panel deployment is thus substantially eliminated. NASA

N70-42347*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 8 MISSION REPORT
Feb. 1969 312 p refs
(NASA-TM-X-66369; MSC-PA-R-69-1) Avail: NTIS CSCL 22A

A postflight analysis of the Apollo 8 mission is presented and includes only the results that are either unique to the lunar environment or are significantly different from those obtained from Apollo 7. Mission aspects covered in the report include: (1) lunar photography; (2) trajectory analysis; (3) command and service module performance; (4) flight crew performance and biomedical evaluation; (5) mission support and launch vehicle performance; and (6) anomaly summary. D.L.G.

N70-42356# Royal Aircraft Establishment, Farnborough (England).
THE ORBIT OF INJUN 3 ROCKET (1962 beta tau 6) FOR NOVEMBER 1966 TO JANUARY 1968
Diana W. Scott Nov. 1969 27 p refs
(RAE-TR-69255) Copyright. Avail: NTIS

Sets of orbital parameters for the Injun 3 rocket were computed for 57 epochs from November 1966 to within 3 months of the end of the satellite's orbital life using 1,300, mainly visual, observations. The accuracy of the orbits varied considerably, but for the best the standard deviations were 0.002 deg in inclination and 100 m in perigee height. Author (ESRO)

N70-42388*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MANNED SPACE FLIGHT
Oct. 1970 6 p
(NASA-TM-X-66373) Avail: NTIS CSCL 22B

Fact sheets on the Apollo, Skylab, space station, and space shuttle programs are presented. The program description, schedule, program officials, funding, and principal contractors are given for each project. N.E.N.

N70-42446*# Hayes International Corp., Birmingham, Ala.
STUDY OF A NONSTATIONARY ADJOINT STATISTICAL WIND MODEL FOR FLIGHT CONTROL SYSTEMS ANALYSIS Final Report
John L. Palmer 28 Feb. 1969 45 p refs
(Contract NAS8-21444)
(NASA-CR-102848; ER-1621) Avail: NTIS CSCL 17G

A turbulence shaping filter was designed for use with the adjoint technique of analysis, or programs formulated with optimal control techniques requiring mean square system response. By determining the appropriate coefficients, the shaping filter can be used to generate the winds and turbulence statistics that are necessary as an input to a dynamic system to obtain the system mean square response due to winds and turbulence input. To use the shaping filter with an adjoint technique of analysis, the shaping filter is joined with the time varying system to form a combined system, that has a white noise input and a response which is the vehicle output that normally results from winds and turbulence. Author

N70-42526# Institut d'Aeronomie Spatiale de Belgique, Brussels.
TABLES OF ARTIFICIAL SATELLITES: 1957 – 1969 [TABLEAU DES SATELLITES ARTIFICIELS: 1957 – 1969]
J. Vercheval 1970 97 p refs In FRENCH; ENGLISH summary
Supplement to Aeronomica Acta No. F-14-1969; see N69-39090 31-23 *Its* Aeronomica Acta No. F-18-1970
Avail: NTIS

This report comprises satellite listings (a) by group name and (b) by launching date and orbital elements. There is a list of manned space flights and details of transmitting frequencies. ESRO

N70-42539# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
THE TWO-METRE THERMAL VACUUM CHAMBER OF THE DFVLR IN PORZ-WAHN [DIE 2-m-THERMAL-VAKUUM-ANLAGE DER DFVLR IN PORZ-WAHN]
Rainer Huett May 1970 81 p refs In GERMAN; ENGLISH summary
(DLR-MITT-70-07) Avail: NTIS; ZLDI Munich: 22 DM

The purpose of thermal vacuum tests for heat budget testing and the electrical checkout of spacecraft are outlined. Comparisons are made between different space environment simulation techniques and their costs. A new thermal vacuum chamber at Porz-Wahn is described and the results of investigations and of tests on the AZUR satellite are given. ESRO

N70-42621# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ANALYSIS OF THE ROTATION AND ORIENTATION OF THE PROTON-2 SATELLITE
W. V. Beletskii et al 22 May 1970 15 p refs Transl. into ENGLISH from Russian Rept. Presented at the 18th Intern. Astronautical Congr., Belgrade, 1967
(AD-710257; FTD-HT-23-270-70) Avail: NTIS CSCL 22/3

The Proton 2 satellite and a model of aerodynamic moments acting on it are considered. There is a considerable propelling effect at the expense of obliquely symmetrical solar cell panels. A theoretical analysis of the evolution of the Proton satellites fast rotation under the effect of aerodynamic moments is given. Among the major effects are: long periodic variations of angular velocity of rotation and the character of rotation from spinning about the longitudinal axis to tumbling and again to spinning. The period of variations is a few tens of the satellites orbits. Information on orientation transmitted from the satellite is considered. The qualitative character of motion is determined by analysis of information. The actual motion and the theory of motion coincide with each other. A method of information processing with a view to determining the satellites orientation is described. Some results of information processing and of determining Proton 2s orientation are given. The obtained results are compared with the results of theoretical analysis. Author (TAB)

N70-42658*# Translation Consultants, Ltd., Arlington, Va.
SOME RESULTS OF THE FLIGHT OF THE SOYUZ-9 SPACECRAFT [NEKOTORYYE ITOGI POLETA KOSMICHESKOGO KORABLYA SOYEZ-9]
A. G. Nikolayev Washington NASA Oct. 1970 12 p Transl. into ENGLISH from Russian Rept. Presented at the 21st Intern. Astronautical Congr., Constance, West Ger., 4 – 10 Oct. 1970
(Contract NASw-2038)
(NASA-TT-F-13381) Avail: NTIS CSCL 22A

The commander of Soyuz-9 reported to the 21st International Astronautical Congress on his 18-day space flight. The personal reactions of the crew, as well as general details on certain work done during the flight was discussed. Author

N70-42667*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METEOROID HAZARD EVALUATION FOR SIMPLE STRUCTURES WITH VARIOUS ORIENTATIONS
C. D. Miller Washington Oct. 1970 70 p refs
(NASA-TN-D-6056) Avail: NTIS CSCL 22A

A statistical analysis was performed using data on photographs

meteors and weighting factors for correction of various biases involved in meteor photography, on the basis of an armor damage criterion. Although the analysis was restricted to earth orbit about the sun, implications are discussed regarding total population of meteoroids throughout the solar system. In earth orbit about the sun, advantage was found for cylindrical armor extending in the solar direction and a plane sheet aligned normal to the apex of earth movement. Author

N70-42672# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBSERVATION OF ARTIFICIAL EARTH SATELLITES: SELECTED ARTICLES
A. Horvath et al 14 Apr. 1970 58 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Astron. Sovet, Nablyudeniya Iskusstv. Sputnikov Zemli (USSR), no. 8, 58 p
(AD-710270; FTD-MT-24-56-70) Avail: NTIS CSCL 22/3

Contents: Comparison of the acceleration due to air drag and to solar radiation pressure in the case of satellite 1963 53 A; The deceleration of satellite 1965-11-4 according to simultaneous observations of INTEROBS and SPIN; One method of more exact determination of the rotation period of a satellite; and A tetraaxial automatic camera for observations of artificial earth satellites. TAB

N70-42826*# Rensselaer Polytechnic Inst., Troy, N.Y. School of Engineering.
ANALYSIS AND DESIGN OF A CAPSULE LANDING SYSTEM AND SURFACE VEHICLE CONTROL SYSTEM FOR MARS EXPLORATION Progress Report, 1 Jul. 1969 - 30 Jun. 1970
15 Jul. 1970 56 p refs
(Grant NGL-33-018-091)
(NASA-CR-113888; RPI-TR-MP-15) Avail: NTIS CSCL 22B

Problems related to landing and controlling a mobile planetary vehicle according to a systematic plan of exploration were investigated. Problem areas considered include: adaptive trajectory control employing discrete drag and/or flight path angle changes; unpowered (autogyro) aerodynamic landing; terrain sensor interpretation and terrain modeling; evaluation of path selection algorithms; vehicle configuration, dynamics, and attitude control; vehicle power systems analysis; onboard navigation systems; satellite-vehicle navigation systems; and chromatographic systems design concept studies. The specific tasks undertaken are defined and the progress achieved during the period July 1, 1969 to June 30, 1970 is summarized. Author

N70-42884*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH ACHIEVEMENTS REVIEW, VOLUME 3. REPORT 11: MICROELECTRONICS RESEARCH FOR SHUTTLE AND SPACE STATION
1970 75 p refs Presented at Huntsville, Ala., 29 Jan. 1970
(NASA-TM-X-64504) Avail: NTIS CSCL 22B

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4. AN MOS/LSI ANALOG-TO-DIGITAL CONVERTER O. Rowe, J. J. Egan, and A. J. Mac Millian p 25-27 (See N70-42888 24-08)

5. COMPUTER-AIDED DESIGN OF MOS/LSI ARRAYS C. E. Winkler p 29-35 (See N70-42889 24-08)

6. ADVANCED AEROSPACE COMPUTER TECHNOLOGY H. Garrett p 37-44 (See N70-42890 24-08)

7. MULTIPLEXED DATA BUS TECHNIQUES FOR ADVANCED AVIONICS SYSTEMS W. O. Frost p 45-57 (See N70-42891 24-09)

8. RELIABILITY EVALUATION OF BIPOLAR LSI MICROCIRCUITS L. Hamiter and F. Laracuente p 49-57 (See N70-42892 24-09)

9. MICROCIRCUITS' 10- TO 15-YEAR SPACE MISSIONS M. F. Nowakowski and F. Villella p 59-63 refs (See N70-42893 24-09)

N70-42885*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MICROELECTRONICS RESEARCH AND TECHNOLOGY FOR SHUTTLE AND SPACE STATION
D. L. Anderson *In its* Res. Achievements Rev., Vol. 3, Rept. 11 1970 p 1-3 (See N70-42884 24-31)
Avail: NTIS CSCL 22B

An overview of research and development in the application of microelectronic technology to aerospace systems is presented. Brief summaries are given of efforts in the following areas: (1) engineering evaluation and testing of LSI chips; (2) design and development of custom chips; (3) application of LSI to electronic systems; (4) advanced packaging technology; (5) long life and reliability; and (6) application of computers to design, layout, and testing of LSI arrays. D.L.G.

N70-42902# Sandia Corp., Albuquerque, N.Mex.
FEASIBILITY OF THERMORADIATION STERILIZATION OF SPACECRAFT USING Co-60
R. M. Jefferson May 1970 35 p refs
(SC-RR-70-301) Avail: NTIS

The feasibility of utilizing thermoradiation sterilization for planetary quarantine of spacecraft depends in part upon the ability to find a source capable of providing a reasonably uniform gamma exposure throughout the vehicle at a rate of about 10,000 R/hr. Early proposals to use the fission product decay gammas from a nuclear reactor fuel system did not provide the needed uniformity although the rate was sufficient. Other suggested sources included cobalt-60 and a 10 MeV accelerator. This report investigates the use of cobalt-60 as a source. By simple arrangement of the cobalt into line sources and by selectively placing these sources in relation to the spacecraft, it is possible to provide a uniform dose of 10,000 R/hr to a typical spacecraft. Suggestions and cost estimates are included for a minimum facility in which to perform such an exposure. Author (NSA)

N70-42931*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH ACHIEVEMENTS REVIEW. VOLUME 3: MATERIALS RESEARCH FOR SHUTTLE AND SPACE STATION
Washington 1969 104 p refs *Its* Res. Achievements Rev. Rept. No. 10
(NASA-TM-X-64521) Avail: NTIS CSCL 22B

Research, development, and nondestructive tests of materials for long term use in space environments are reviewed. Data include the problems encountered on bearings and lubricants, outgassing and offgassing, vacuum deposition and redeposition, and thermal radiation effects on the windows. Also included are space processing of materials especially crystal growth in null gravity, and nondestructive tests of the space shuttle. The nuclear technology involved in the development of materials and the synergistic effects of materials in a nuclear environment are discussed. E.H.W.

N70-42977*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURAL DESIGN TECHNOLOGY: INTRODUCTION AND OVERVIEW

R. W. Leonard *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 9–16 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

A brief overview is given of the current NASA plan for development of space shuttle structural design technology. Eight major tasks spanning design criteria, methods, advanced concepts, efficient design definition, prototype tests, and actuated structure are broken down to show the principal elements proposed for the FY-71 R and D program. Author

N70-42978*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPACE SHUTTLE STRUCTURAL DESIGN CRITERIA DEVELOPMENT
L. F. Vosteen *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 17–32 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The elements of the current NASA structural design criteria development are outlined, and the special problems that require additional study before more specific criteria can be prepared are discussed. The development program was initiated to develop structural design criteria specific to the shuttle mission but independent of the vehicle configuration; to define the critical criteria related problems and effect their solution; and to provide a basis for preparing vehicle-specific criteria and specifications. Author

N70-42979*# General Dynamics/Convair, San Diego, Calif.
SPACE SHUTTLE STRUCTURAL FATIGUE CONSIDERATIONS
G. L. Getline and W. H. Schaefer *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 33–47 ref (See N70-42976 24-30)
Avail: NTIS CSCL 22B

Fatigue, not only of materials but also of fabricated and joined structures, is discussed. Descriptions are given of major areas of low and high cycle fatigue on a space shuttle configuration, cumulative fatigue damage analysis, materials and structural arrangements being considered, and the overall technical approach for an optimum design solution. Author

N70-42980*# Boeing Co., Seattle, Wash.
THE DEVELOPMENT OF EFFECTIVE FRACTURE CONTROL PROCEDURES FOR SPACE SHUTTLE
C. F. Tiffany *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 49–60 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

Specific causes of structural failures and elements of effective control are outlined. It is felt that the manner in which the government and contractors go about contracting and designing flight systems has contributed to premature failure problems, and examples are given. A combination of fail-safe and safe-life design concepts is considered to be preferred for the space shuttle. N.E.N.

N70-42981*# National Aeronautical Establishment, Ottawa (Ontario).
STRUCTURAL DESIGN AND ANALYSIS OF THE SPACE SHUTTLE
G. R. Cowper, E. Kosko, G. M. Lindberg, and M. D. Olson *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 61–71 refs (See N70-42976 24-30)
Avail: NTIS CSCL 22B

Special features of the vehicle are outlined together with structural and thermal problem areas requiring the use of advanced methods. Existing methods and analytical tools are reviewed, and a survey is made of areas in need of improvement. The basic tool is matrix analysis based on the finite element approach. There is need for updating available programs by including improved or refined finite elements. One example shows the advantages of such refined finite elements. A second example deals with a problem of random structural response solved with the help of finite elements. Author

N70-42982*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATIONS OF ADVANCED COMPOSITE MATERIALS TO SPACE SHUTTLE STRUCTURES
Richard A. Pride and Michael F. Card *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 73–92 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The NASA programs for composite space shuttle structures are reviewed. Programs at MSFC, LeRC, LaRC are presently focused on beam, truss, stiffened plate, and pressure vessel applications. The cost-weight advantages of the concept of reinforcing metals selectively with composite materials are discussed. An assessment of current composite technology is made and guidelines for composite applications are proposed. Author

N70-42983*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
SECONDARY STRUCTURES AND MECHANISMS: DESIGN TROUBLE AREA FOR THE SPACE SHUTTLE
Eldon E. Kordes *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 93–99 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The design of secondary structures and mechanisms for a reusable space shuttle can produce problems as serious as those involved in designing the primary structure and thermal protection system. Several events involving failure of secondary structures during the X-15 flight program have been selected to illustrate potential problem areas. Similar problems may be expected on future reusable vehicles until additional research provides adequate design information in these areas. Author

N70-42985*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE SHUTTLE STRUCTURAL PROTOTYPE DESIGN, FABRICATION, AND TEST
E. E. Engler *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 123–138 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

A program for testing materials and structures is outlined, including inspection and quality assurance. Primary attention is given to weight and cost, structure integration, fail-safe structure, and design for reuse, inspection, and refurbishment. It is concluded that the program will establish design techniques and hardware experience necessary to minimize development risks of the space shuttle. N.E.N.

N70-42986*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL PROTECTION SYSTEMS: INTRODUCTION AND OVERVIEW
W. A. Brooks, Jr. *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 139–144 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

Although weight is important because of the shuttle's small payload margin, the most demanding requirement for thermal protection systems is an extended service life with as many as 100 entries with minimal refurbishment. A summary of the proposed NASA Space Shuttle Thermal Protection Systems Technology Program is given with a listing of the major task areas and the identification of the NASA Centers working each area. The summary consists of activities initiated in FY 70 (most of which continue into FY 71) and proposed new starts for FY 71. Author

N70-42987*# Grumman Aerospace Corp., Bethpage, N.Y.
SUPERALLOY HEAT SHIELD TECHNOLOGY FOR THE SPACE SHUTTLE
W. A. Wolter and R. T. Ratay *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 145–158 ref (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The applicability of the available superalloys, required design features, insulations systems, and remaining problem areas are discussed. The results of a test program in progress, which is directed toward investigating solutions to these problems, are presented. It is concluded that for temperatures up to 1800 F, the metallic heat shield panel utilizing nickel and cobalt superalloys holds promise for a practical, reliable, and reasonably efficient reuseable thermal protection system. It appears particularly applicable to the low crossrange orbiter and the booster. Author

N70-42991*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-COST ABLATIVE HEAT SHIELDS
R. T. Swann *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 195–200 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The ablative heat shield technology program emphasizes cost and replacement aspects of the problem, with some attention directed to thermal performance. Manufacturing, quality assurance, and panel replacement costs and procedures are studied for particular high heating rate areas such as leading edges as well as for broader vehicle areas where other technology may not develop as rapidly as expected. Author

N70-42992*# North American Rockwell Corp., Downey, Calif.
TEMPERATURE CONTROL FOR THE SPACE SHUTTLE
W. E. Neuenschwander *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 201–207 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The influence of the thermal control system on the design requirements and operational capability of the space shuttle orbiter are discussed in terms of the thermal environments experienced during the pad-hold, launch, on-orbit, entry, postlanding, and ferry phases of a shuttle mission. Potential temperature excursions are compared to temperature allowables of various equipment and the effect of some candidate temperature control concepts on vehicle weights/design requirements are illustrated. Candidate thermal control techniques are discussed and an evaluation/design approach for selecting the optimum thermal control system, an integrated thermal management system, is described. Author

N70-42993*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THERMAL PROTECTION SYSTEM REFURBISHMENT COST STUDY
R. W. Goldin and R. J. Peterson *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 209–228 (See N70-42976 24-30)
(Contract NAS 1-10094)
Avail: NTIS CSCL 22B

While refurbishment cost data are of great significance and interest to the space-shuttle program, in this study there is equal emphasis on identifying the degree of cost uncertainty of major elements of TPS maintenance operations. With priority uncertainty areas determined, study and/or test plans are to be formulated to reduce these maintenance cost uncertainties. Heat shields, and associated hardware, for use in these tests are to be designed to be compatible with a full-scale mockup at Langley Research Center. Author

N70-42996*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MATERIALS REUSE, EVALUATION, INSPECTION AND REPAIR
Eugene C. McKannan *In its* Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 247–260 refs (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The properties of alloys and metal coatings for space shuttles are discussed. These include mechanical properties, metallurgical structure, surface structure, and emissivity. Nondestructive inspection and field repair techniques are also mentioned. It is concluded that the primary thermal protection shield life limitations are first creep and total deformation in the panel, and second thermal stability of the microstructure or changes in the grain size, and finally flaws that may occur in the coating. N.E.N.

N70-42997*# General Electric Co., Philadelphia, Pa.
THE IMPORTANCE OF NONDESTRUCTIVE TESTING FOR THE COATED METALLIC THERMAL PROTECTION SYSTEM
R. C. Stinebring and A. E. Oaks *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 261–272 refs (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The systematic approach to nondestructive testing (NDT) and the state-of-the-art of NDT for coated metallics are discussed. In-process NDT evaluation, systems checkout and prelaunch evaluation, and NDT assessment of reusability are outlined. Thermoelectric probing, backscatter X-ray or electron emission test, and eddy current techniques are described. N.E.N.

N70-42998*# North American Rockwell Corp., Downey, Calif.
MATERIALS PROPERTIES AND ALLOWABLES FOR THE SPACE SHUTTLE
L. K. Crockett and W. E. Witzell (Gen. Dyn./Convair, San Diego, Calif.) *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 3 Jul. 1970 p 273–287 (See N70-42976 24-30)
Avail: NTIS CSCL 22B

The requirements and applications of materials are outlined. The major material areas are metallic thermal protection system and hot structure, reusable nonmetallic thermal protection system, primary structure and tank materials, high temperature and cryogenic insulation, crew compartment materials, and nonstructural materials. N.E.N.

N70-43007*# Grumman Aerospace Corp., Bethpage, N.Y.
AIRCRAFT FLIGHT DISPLAY/CONTROL INFORMATION RESULTS AND THEIR RELEVANCE TO SHUTTLE APPLICATION
M. Pollack *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 7 Jul. 1970 p 31–34 (See N70-43004 24-30)
Avail: NTIS CSCL 22B

The requirement that redundant, multipurpose, computer-operated displays be considered for providing both flight path and system status information is considered. Some of the results derived from more than 12 years of design and development experience in computer-driven integrated displays are summarized, and those findings which are applicable to space shuttle design are highlighted. Author

N70-43008*# North American Rockwell Corp., Downey, Calif. Space Div.
PACING CREW SYSTEMS TECHNOLOGY OBJECTIVES FOR SSV DEVELOPMENT
Donald B. Morris *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 7 Jul. 1970 p 37–58 (See N70-43004 24-30)
Avail: NTIS CSCL 22B

The space shuttle flight crew system is defined as the flight control crew and passenger payload and support systems required for onboard control, crew performance, comfort, and survival.

Identifications and descriptions of crew systems technology areas applicable to configuration definition and subsystem elements are examined. Crew and passenger needs requiring analytic or empirical processes for resolution with respect to space shuttle configurations and subsystems studies and preliminary design definition are considered. Author

N70-43010*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE SHUTTLE VEHICLE ENVIRONMENTAL-THERMAL CONTROL AND LIFE SUPPORT TECHNOLOGY
E. L. Hays *In its* Space Transportation System Technol. Symp., Vol. 7, Jul. 1970 p 75-84 (See N70-43004 24-30)
Avail: NTIS CSCL 22B

A detailed presentation is given on the design and performance problems of humidity control systems and of evaporative type heat exchangers. The problems associated with the orbital heat rejection systems are discussed and the various possible concepts of suborbital cooling are presented. The utilization of a space suit for personnel protection for early flight tests is discussed and a possible suit design is described. The current liquid and solid waste management systems are described and essential modifications for space shuttle utilization are defined. Non-metallic materials development programs is reviewed and an attempt is made to establish the requirements for these materials in the shuttle type vehicle. Author

N70-43011*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CREW AND CARGO TRANSFER
Gary P. Beasley and Charles M. Lewis *In its* Space Transportation System Technol. Symp., Vol. 7 Jul. 1970 p 85-96 (See N70-43004 24-30)
Avail: NTIS CSCL 22B

A program to define and develop the personnel and cargo transfer capabilities required to support the space shuttle missions is discussed. The program is geared to provide information for the Phase C shuttle studies and to develop techniques and systems necessary for the planned transfer tasks. Author

N70-43012*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APPLICATION OF CURRENT SPACECRAFT SIMULATION TECHNIQUES TO SHUTTLE
Warren J. North *In its* Space Transportation System Technol. Symp., Vol. 7 Jul. 1970 p 97-113 (See N70-43004 24-30)
Avail: NTIS CSCL 22B

The simulation techniques used in development of Gemini and Apollo equipment are discussed with respect to their application to space shuttle development. Some of the operational differences affecting crew procedures, simulation, and training are reviewed. R.B.

N70-43013*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESULTS OF PICTORIAL DISPLAY STUDIES WITH POTENTIAL APPLICATION TO ORBITER APPROACH AND LANDING
T. Wempe *In its* Space Transportation System Technol. Symp., Vol. 7 Jul. 1970 p 115-118 (See N70-43004 24-30)
Avail: NTIS CSCL 22B

The utilization of pictorial displays that are independent of the instrument landing system for pilot monitoring and control during approach and landing with zero visibility out the window is discussed. The pictorial display research is based on initial light plane simulation and is applicable to displays for heavy jet aircraft and the high L/D and low L/D space shuttle vehicles. The proposed independent landing monitor is based on a cathode ray tube pictorial display of the terrain ahead of and below the vehicle. R.B.

N70-43031# International Geophysical Year World Data Center A, Greenbelt, Md.
CATALOGUE OF DATA IN WORLD DATA CENTER A ROCKETS AND SATELLITES: DATA RECEIVED BY WDC-A DURING THE PERIOD 1 JULY-31 DECEMBER 1969
Mar. 1970 55 p refs Supported by NAS
Avail: Issuing Activity

Summaries of sounding rocket, artificial earth satellite, and space probe launchings received at World Data Center A are reported. A subject index is included on reports and reprints received during the period July 1 to December 31, 1969. R.B.

N70-43040# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
WIND TUNNEL MEASUREMENTS ON THE ERNO LB 1 AND LB 10 REENTRY BODIES [WINDKANALMESSUNGEN AN MODELLEN DER WIEDEREINTRITTSFLUGKOERPER ERNO LB 1 UND LB 10]
H. Esch Jun. 1970 66 p In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-36) Avail: NTIS; ZLDI Munich: 13.85 DM

The aerodynamic characteristics of two lifting reentry-configurations, based on elliptical cones, are described. The ability of both of the models to fly at subsonic and supersonic speeds was investigated. Six-component measurements were made at Mach numbers of 0.5, 1.56 and 4.52. The Reynolds number, based on model length, varied between 3 million and 19 million. Author (ESRO)

N70-43085*# California Univ., Los Angeles. School of Engineering and Applied Science.
A STUDY FOR THE COMPARATIVE EVALUATION OF ATTITUDE CONTROL SYSTEMS Final Report
Peter W. Likins Jul. 1970 313 p refs Prepared for JPL
(Contract NAS7-100; JPL-952584)
(NASA-CR-110904; UCLA-ENG-7070) Avail: NTIS CSCL 22B

The twofold objectives are described of (1) selecting a competitive alternative to the reaction wheel attitude control system originally selected by JPL for tentative incorporation into a spacecraft for a multiplanet mission, and (2) establishing an improved basis for evaluation of the merits of the chosen alternative by increasing design efficiency beyond that incorporated in JPL preliminary studies of design alternatives. Specifically, the problem of fuel-optimal small angle reorientation of a dual-spin vehicle is solved, with dramatic improvements over previously published responses to this problem. Results are applied (suboptimally) to the large-angle turn problem, and propellant requirements are estimated for the dual-spin vehicle on a multiplanet mission. Author

N70-43161*# TRW Systems Group, Redondo Beach, Calif.
ORBITING GEOPHYSICAL OBSERVATORY ATTITUDE CONTROL SUBSYSTEM DESIGN SURVEY. NASA/ERC DESIGN CRITERIA PROGRAM, GUIDANCE AND CONTROL
K. J. McKenna and H. Schmeichel 28 Jun. 1968 80 p refs
(Contract NAS12-110)
(NASA-CR-110886) Avail: NTIS CSCL 22B

A design survey summarizing the history of the Orbiting Geophysical Observatories' (OGO) attitude control subsystem (ACS) from the proposal phase through flight experience is presented. Problems encountered in design, fabrication, test, and on orbit are discussed. The ACS requirements, operation, and equipment are described. The ACS development is covered from the proposal phase through December 1961 when the design requirements were finalized. Development of the ACS hardware from January 1962 to the first launch is also covered and significant problems which occurred during the development phase are discussed. The problems which occurred during the first five OGO flights and a brief summary of the flights are given. As a result of the flight experience, several ACS changes were made as well as changes in the flight operations philosophy. Author

N70-43165*# Boeing Co., Seattle, Wash.
EVALUATION OF NINE LUNAR MODELS FOR APOLLO
Gayle D. Barrow 24 Apr. 1969 383 p refs
(Contract NAS1-7954)
(NASA-CR-66761; D2-100820-1) Avail: NTIS CSCL 22B

Various lunar gravitational models were evaluated for Apollo mission control using checkpoint techniques developed previously. All checkpoints were selected from low inclination Lunar Orbiter missions in order that the results would be applicable to the Apollo missions. Identical techniques were used for each model evaluated in order that relative performance could be determined. Author

N70-43194*# TRW Systems Group, Redondo Beach, Calif.
TASK 3 SPACE STORABLE PROPELLANT MODULE ENVIRONMENTAL CONTROL TECHNOLOGY Summary Report
R. E. De Land, O. O. Haroldsen, and R. N. Porter 1 Jun. 1970 74 p refs
(Contract NAS7-750)
(NASA-CR-110941; TRW-14051-6004-T0-00) Avail: NTIS CSCL 22B

Analyses and design studies were made of the two thermal control systems to specify which is the better system for an OF2/B2H6 propulsion module. Areas of investigation included: (1) type of groundhold propellant coolant to be used; (2) type of propellant cooling coils to be used; (3) manner in which the helium tank temperature can best be controlled during flight; and (4) insulation configuration for groundhold and flight. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N70-41837 Rice Univ., Houston, Tex.
OPTIMIZATION OF STEEL BEAM-COLUMNS
Kent La Verne Goering (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-19291

The minimum weight design of steel beam-columns which conform to the working stress provisions of the A.I.S.C. specifications is formulated as a calculus of variations problems with inequality constraints. It is shown that for an optimum beam-column, the bending-axial compressive stress constraint must always be active. An analytical solution is given for optimum prismatic columns. Optimum proportions for prismatic beam-columns are found numerically using the gradient projection method of nonlinear programming. The optimum depth increases with both moment and axial load. An extension to nonprismatic members is made to find an optimum linear and parabolic taper for nonprismatic columns. An algorithm for the cost optimization of nonprismatic beam-columns using discrete plate sizes is developed. Theoretical and computational difficulties arise with the dynamic programming procedure, but the algorithm converges to a design that is thought to be nearly optimal. Dissert. Abstr.

N70-41841# Naval Research Lab., Washington, D.C. Strength of Metals Branch.
PROCEDURES FOR STRESS-CORROSION CRACKING CHARACTERIZATION AND INTERPRETATION TO FAILURE-SAFE DESIGN FOR HIGH-STRENGTH STEELS Final Report
R. W. Judy, Jr. and R. J. Goode 29 Nov. 1969 16 p refs
(AD-703210; NRL-6988) Avail: NTIS CSCL 11/6

The recently evolved ratio analysis diagram (RAD) procedure is a useful engineering tool for generalized assessment of the fracture resistance of high-strength steels. Failure-safe design of a large complex structures also requires consideration of subcritical crack growth caused by stress-corrosion cracking (SCC). Procedures developed to incorporate SCC characterizations into the RAD concept provide a more complete analysis of a material's resistance to fracture. The SCC-Dual RAD for high-strength steels presents simplified interpretations of the critical flaw size-stress instability conditions for both slow fracture (SCC) and fast fracture of these materials. Author (USGRDR)

N70-41887# National Aeronautical Lab., Bangalore (India).
STRESS DISTRIBUTION AROUND TIPS OF NOTCHES HAVING ARBITARY CONFIGURATIONS
S. A. Hussainy, H. Mohamed Hasseem, and G. K. Bhagawan Oct. 1969 18 p refs Submitted for publication
(NAS-TN-19) Avail: NTIS

It was observed by a photoelastic investigation of the stress distribution around slender notches having arbitrary configurations, that the symmetric-antisymmetric and asaymmetric nature of the configuration rather than the overall geometry controls the stress distribution around the notch tip. Since the peak stresses are found to be on the conservative side for symmetric configurations, it is suggested that the available theoretical expressions for the stress intensity factor of an equivalent circular arc crack be utilized for further work on crack propagation studies. Author

N70-41895*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMPIRICAL CORRELATION OF SMALL HOLLOW SPHERE IMPACT FAILURE DATA USING DIMENSIONAL ANALYSIS
Richard E. Morris Sep. 1970 27 p refs
(NASA-TM-X-52874) Avail: NTIS CSCL 20K

Correlation equations were obtained for published experimental small hollow sphere-impact data. The equations for failure deformation and velocity as a function of mean radius, thickness, and ultimate strain are given. Sphere materials included SAE 4130 steel, titanium, and Haynes Alloy No. 25. Diameters varied from 0.750 to 2.000 inches. Failure velocities varied from 297 to 650 ft/sec. The correlation equations were used to calculate the failure velocity and deformation of a 17 ft diameter containment vessel for a nuclear reactor. The deformation at failure was 7.0 ft at an impact velocity of 900 ft/sec (274 m/sec). The equations indicate that a multilayer spherical containment vessel probably would have greater impact strength than a corresponding single wall vessel. Author

N70-41905*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PLANE ELASTOSTATIC ANALYSIS OF V-NOTCHED PLATES
Bernard Gross and Alexander Mendelson Washington Oct. 1970 30 p refs
(NASA-TN-D-6040; E-5437) Avail: NTIS CSCL 20K

Solutions are given for several plane elastostatic problems of plates having a v-notch on one edge, and subjected to a variety of boundary conditions. The effect of the magnitude of the v-notch angle and specimen geometry on stress intensity factors K sub 1 and K sub 2 are obtained for unloaded notch surfaces. Examples are given of notch surface displacements for several selected cases. Analytical solutions are formulated but not computed for the case of a loaded notch surface or one with prescribed boundary surface displacements. Notch opening displacements at the plate edge were measured experimentally and the results obtained were in excellent agreement with the computed results. Author

N70-41908 Cornell Univ., Ithaca, N.Y.
A FINITE ELEMENT FORMULATION FOR STABILITY ANALYSIS OF DOUBLY CURVED THIN SHELL

STRUCTURES
Henry Tzu-Yow Yang (Ph.D. Thesis) 1969 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-10444

Stiffness equations are formulated in representation of the elastic instability behavior of a doubly curved thin shell element. The element is in the form of a shell of translation of constant thickness and constant principal radii of curvature. The derived relationships are expressed in curvilinear coordinates. An approximate method of eliminating unwanted degrees of freedom from the statement of the buckling eigenvalue problem is applied. Illustrative examples cover the utilization of the element in plate, cylinder, and doubly curved shell elastic instability problems with known solutions. Related comparisons assess the accuracy of the basic formulation, the approximate reduction procedure, and the ability of the present formulation to deal with special features of cylinder buckling. Dissert. Abstr.

N70-41974 IIT Research Inst., Chicago, Ill.
ENERGY METHODS FOR STRESS AND BUCKLING ANALYSES OF FOLDED PLATES
Michel Latif Mikhail (Ph.D. Thesis) 1969 252 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.25 Order No. 69-18615

The material is assumed to be homogeneous, isotropic and linearly elastic with all stresses in the structure smaller than the proportional limit. The stress analysis utilizes the two-dimensional elasticity theory for the plane stress problem and the small deflection theory of thin plates under the combined action of lateral and in-plane loads. It also makes use of the Rayliegh-Ritz method to determine an approximate solution of the boundary value problem. The analysis differs from previous work in that it takes into account the previously neglected effect of the in-plane forces on the deflection fields of the plate elements. The buckling analysis is concerned with the problem of local buckling of the individual plate elements of the structure and treats the case of symmetrical buckling only. Raleigh's principle was used to determine the buckling loads. Dissert. Abstr.

N70-42003* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE TESTING DEVICE Patent
Eugene C. Naumann and Emmett L. Bryant, inventors (to NASA) Issued 21 Feb. 1967 (Filed 24 Jun. 1964) 13 p Cl. 73-90
(NASA-Case-XLA-02131; US-Patent-3,304,768;
US-Patent - Appl - SN-377777) Avail: US Patent Office CSCL 20K

A fatigue testing machine is described which applies a predetermined load program, consisting of a series of discrete load levels and programmed on a set of punched cards, to a test specimen. The device produces precise loads of any desired magnitude and can be programmed to perform any fatigue test. A group of potentiometers have adjustable sliders so that each potentiometer produces a discrete electrical signal proportional to one of the discrete load levels. Selection of the output of one of the potentiometers involves switching logic and a group of relays. Means for applying a load to the specimen in accordance with an error electrical signal include a hydraulic ram which applies the load, a pump to supply liquid to the ram, and a servo valve connected between the two and controlled by the error signal. The device is particularly applicable to aircraft structural fatigue tests. P.A.B.

N70-42005 National Lending Library for Science and Technology, Boston Spa (England).
THE STRESSES IN A SPHERICAL SHELL UNDER AXISYMMETRIC HEATING [NAPRYAZHENIYA V SFERICHESKOI OBOLOCHKE PRI OSESIMMETRICHNOM NAGREVE]
V. D. Afinogenov Jul. 1970 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mat. I Mekhan. (Moscow), no. 2, 1968 p 95-98
(NLL-RTS-5887) Avail: Natl. Lending Library, Boston Spa, Engl.: 12 s; 2 NLL photocopy coupons CSCL 20/11

A mathematical model is presented for the calculation of temperature stresses on spherical shells heated axisymmetrically. Assuming that the temperature depends linearly on the wall thickness, temperature stresses in shells formed by surfaces of revolution are defined by a system of differential equations which include Meissner variables, angles of rotation in the meridian section, curvature radii of the shell mean surface, differential operators, inner and outer shell surface temperatures, the modulus of elasticity, and Poisson coefficients. Normal stresses, shearing force, and deformation moments are associated with the meridian section angle of rotation and Meissner variables in temperature stress cases. Temperature stresses and moments in the shell are calculated for a thin-walled spherical shell freely supported on a smooth surface. J.M.

N70-42062# Idaho Nuclear Corp., Idaho Falls.
STRAP: A COMPUTER CODE FOR STATIC AND DYNAMIC STRUCTURAL ANALYSIS AND STUDIES MADE USING THE CODE
J. A. Dearien, C. Noble, and E. D. Uldrich Jun. 1970 43 p refs
(Contract AT(10-1)-1230)
(IN-1362) Avail: NTIS

The computer code STRAP (STRuctural Analysis Package), developed to perform static and dynamic analyses of reactor structural systems, is described. The code uses the finite element method to model a structure and an uncoupled modal summing procedure to perform the dynamic analysis. STRAP is a three-dimensional structural analysis code and can be used in the static and dynamic analyses of structures having up to 250 degrees of freedom. Studies on structural modeling techniques were made using the code, and guidelines are given for the modeling process.. Author (NSA)

N70-42088*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STABILITY OF A TWO-DEGREE-OF-FREEDOM SYSTEM WITH STATIC AND IMPULSIVE LOADING
Mitchell Cash 24 Jul. 1970 62 p refs
(NASA-TM-X-64531) Avail: NTIS CSCL 20K

Energy methods are used to determine the stability of a nondimensional two-degree-of-freedom column model under static and impulsive loading. A soft spring is used to create instability, and provision is made for initial imperfections. Stability is investigated at the static buckling load and at the saddles of the deflected system without a static load, and the difference is noted. Solution curves are determined for initial conditions to equal the saddle critical potential energy, and the excess initial energy required for collapse of the system is determined for various conditions. A numerical integration is used to determine the system responses. The effects of the various system parameters on the response are discussed. Author

N70-42100*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ON THE SHARPNESS OF CRACKS COMPARED WITH WELLS' COD
J. E. Srawley, J. L. Swedlow, and E. Roberts, Jr. Sep. 1970 6 p refs Submitted for publication
(NASA-TM-X-52904) Avail: NTIS CSCL 20K

Crack opening displacements (COD) measured at convenient gage locations on practical specimens were related to displacements elsewhere, particularly near the crack tip, in the expectation that some function of the near-tip displacements would characterize the potentiality for crack extension. The finite element method admits

real material characteristics, and those of a maraged steel were used with a yield strength of 186 ksi and tensile strength of 200 ksi. The element map for half the bend specimen was identical to that for a quadrant of the tension specimen. The triangular elements varied in size, the smallest internodal distance being 1/320 of the crack length. The specimens were loaded through prescribed boundary displacements which were matched so that the stress intensity factors for the two specimens were the same at any given loading state. The deformation patterns resulting from imposed tension and bending were compared directly and it was found that the distance from the crack tip at which the COD occurs is much greater than the magnitude of the COD and that the COD region is not a very distinctive feature of the crack profile. J.M.

N70-42140*# Southwest Research Inst., San Antonio, Tex.
THE RESPONSE OF CYLINDRICAL SHELLS TO RANDOM ACOUSTIC EXCITATION OVER BROAD FREQUENCY RANGES Final Report
Daniel D. Kana, Wen-Hwa Chu, and Roger L. Bessey 1 Sep. 1970 103 p refs
(Contract NAS8-21479; SwRI Proj. 02-2396)
(NASA-CR-102876) Avail: NTIS CSCL 20K

The response of a closed cylindrical shell is determined for acoustic excitation which is random in time but deterministic in space. Two slightly different formulations of the statistical energy method are utilized to compute shell displacement and interior pressure responses which are compared with measured values in 1/3-octave frequency bands. Structural damping estimates are based on linear viscoelastic theory. Various 1/3-octave band averages are defined for computing other frequency-dependent parameters for the system. Overall agreement between theoretical and experimental results for shell response is achieved when the nonideal characteristics of the 1/3-octave filters are accounted for. On the other hand, agreement for interior pressure response is less satisfactory. A detailed discussion is given for several possible sources of discrepancy. Author

N70-42171*# Boeing Co., Seattle, Wash. Launch Systems Branch.
INVESTIGATION OF VIBRO-ACOUSTIC RESPONSE USING NONDIMENSIONAL CORRELATION FACTORS
K. C. Redmond and R. H. Butler 19 Feb. 1970 79 p refs
(Contract NAS8-24926)
(NASA-CR-102865; D5-17058) Avail: NTIS CSCL 20K

A feasibility study concerning the correlation of a simple vibro-acoustic transfer function with various structural and acoustic parameters, to provide a basis for developing a method to predict the vibration response of launch vehicle and payload structures to rocket and flight noise, is discussed. Vibration and acoustic flight and test data generated during the Saturn 1B and Saturn 5 programs were used to generate the vibro-acoustic transfer functions furnished for analyses. The first task of the study was to develop rational data selection criteria empirically designed to accommodate the available data. A brief descriptive assessment of these criteria, in terms of implications and motivations, is given. The results of initial evaluation and assessment of the available data are summarized, and an evaluation of selected structural and acoustic parameters is presented. The applicability of nondimensional parametric forms is decussed. Some of the major statistical models that were used in the study are outlined and briefly described. Parameters identified as worth further detailed study are vehicle diameter, acoustic efficiency, and transmission loss. Author

N70-42172*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
NONLINEAR DYNAMIC ANALYSIS OF STRUCTURES VOLUME 2: STRUCTURAL JOINT DAMPING Final Report
C. S. Chang Jun. 1970 64 p refs
(Contract NAS8-21435)
(NASA-CR-102854; HREC-1435-2; LMSC/HREC-D149171-II) Avail: NTIS CSCL 20K

Results of detailed studies of simple joint damping are presented. In particular, the dissipation between two elastic plates pressed together by mechanical fasteners and experiencing relative dynamic deformations is discussed. Experimental studies are employed to develop a working engineering theory of the contact damping problem. Author

N70-42215# Massachusetts Inst. of Tech., Cambridge. Dept. of Naval Architecture and Marine Engineering.
A THEORETICAL STUDY OF THE DYNAMIC PLASTIC BEHAVIOR OF BEAMS AND PLATES WITH FINITE-DEFLECTIONS
Norman Jones May 1970 56 p refs
(Contract N00014-67-A-0204-0032)
(AD-710010; Rept-70-14) Avail: NTIS CSCL 20/11

An approximate theoretical procedure was developed in order to estimate the permanent transverse deflections of beams and arbitrarily shaped plates which are subjected to large dynamic loads. The influence of finite-deflections or geometry changes is retained in the analysis but elastic effects are disregarded. The particular case of a fully clamped rectangular plate acted on by a uniformly distributed dynamic pressure pulse is studied in some detail. It is observed that reasonable agreement between the theoretical predictions and the experimental results were obtained for beams and rectangular plates which were made from a strain-rate insensitive material. Author (TAB)

N70-42286# Norges Tekniske Hoegskole, Trondheim. Institutt for Flyteknikk.
WEIGHT OPTIMIZATION OF STRUCTURAL SANDWICH PANELS Final Technical Report, Jun. 1969 - Jun. 1970
J. Lockwood Taylor Jun. 1970 47 p refs
(Contract DAJA37-69-C-1224)
(AD-709656; E-1404) Avail: NTIS CSCL 13/13

The report covers the application of a simple method, primarily numerical, to the problem of the optimum design of structural sandwich panels of several types and several materials. Compression and shear loading on flat panels and compression on curved panels have been considered. Including variation of panel proportions, four basic cases are studied for four different face materials, two grades of Al alloy, Ti alloy and stainless steel. The core properties assumed are those appropriate to metal honeycomb. The effect of varying core density is allowed for where such variation seems necessary in order to prevent skin wrinkling of the alternative panel designs whose weight is being compared, subject to an assumed overriding minimum practicable density. The weight penalty arising from increase in core stiffness and density above the minimum differs for different face materials. Author (TAB)

N70-42310# Catholic Univ. of America, Washington, D.C. School of Engineering and Architecture.
STRESSES IN A PRESSURIZED RIBBED CYLINDRICAL SHELL WITH A REINFORCED CIRCULAR HOLE INTERRUPTING A RIB Final Report
A. J. Durelli, V. J. Parks, K. Chandrashekhara, and J. Norgard Jul. 1970 37 p refs
(Contract N00014-67-C-0346)
(AD-709561; Rept-5) Avail: NTIS CSCL 20/11

The stresses in a ribbed cylindrical shell with a reinforced circular hole intersecting one of the ribs are analyzed when the shell is subjected to internal pressure. Several experimental methods were used: brittle coatings, electrical strain gages and the photoelastic freezing technique. The results obtained here were compared with those corresponding to a ribbed shell with a reinforced circular hole between two ribs, a ribbed shell with a nonreinforced circular hole, an unribbed shell with a reinforced circular hole and an unribbed shell with a nonreinforced circular hole. Author (TAB)

N70-42318*# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
FOUNDATION INVESTIGATIONS NASA MISSISSIPPI TEST FACILITY. REPORT 4: DYNAMIC BEHAVIOR OF PILING DURING INITIAL TEST FIRINGS ON THE SC-IC AND S-II TEST COMPLEXES
Jack Fowler Jun. 1970 123 p refs Sponsored by NASA
(NASA-CR-114266; AD-708555; S-69-10) Avail: NTIS CSCL 13M

The Mississippi Test Facility is the site of test stands built to test the first and second stages of the Saturn 5 space vehicle. The stands were instrumented to obtain foundation base pressures, lateral wall pressures, and pile loads during and after test firings of the Saturn V engines. The S-IC stage of the vehicle was statically tested at 7,500,000-lb thrust in a dual-position stand on a reinforced concrete foundation supported by vertical and battered H piles. Soil stress meters were installed beneath the foundation and on the walls to measure base and lateral wall pressures. Pore pressure cells were installed to measure hydrostatic pressure. Strain gages measured axial and shear loads. The S-2 stage of the vehicle was statically tested at 1,000,000-lb thrust in a single-position stand on a split-level reinforced concrete foundation supported by vertical and battered H piles; soil stress meters and pore pressure cells were installed beneath the foundation and on the walls, and strain gages measured axial and shear pile loads.
Author (TAB)

N70-42320# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics
ANALYSIS OF UNBOUNDED CONTACT PROBLEMS THROUGH APPLICATION OF AN OPTIMIZATION TECHNIQUE
Kyung E. Yoon and Kwan Rim Apr. 1970 33 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-709578; THEMIS-UI-19) Avail: NTIS CSCL 20/11

The report discusses a new approach to the solution of certain contact stress problems by utilizing optimization technique as an analytical tool. It is shown that an unbonded contact problem may be posed as an optimization problem, and that the contact stress distribution as well as the area of contact can be determined through a simple application of the linear programming technique. As an example, the problem of an infinite beam pressed against an infinite half plate by a concentrated force is analyzed. By means of this approach it would be possible to conduct an analytical investigation of a large class of unbonded contact problems arising from the structural systems of weapons and vehicles.
Author (TAB)

N70-42322 Polytechnic Inst. of Brooklyn, N.Y.
ASYMPTOTIC SOLUTION FOR PRESSURIZED NONCIRCULAR CYLINDERS WITH NON-UNIFORM REINFORCING RINGS
Joseph E. Flaherty (Ph.D. Thesis) 1969 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-17791

An asymptotic expansion procedure is used to analyze a hydrostatically loaded noncircular cylindrical shell which is reinforced by nonuniform rings. The procedure makes use of two distinct characteristic lengths to construct two asymptotic series, which, when combined, give the total solution. All stress resultants and deflections are obtained explicitly. The results are presented as solutions of Love type equations. Numerical results are compared with existing solutions for doubly symmetric oval shells reinforced by uniform rings. The cross sections of these cylinders range from circular to ovals having a major to minor axis ratio of 1.3. Numerical results are also presented for the first time for oval cylinders reinforced by nonuniform oval rings. Cases of both singly and doubly symmetric rings are considered.
Dissert. Abstr.

N70-42324*# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
FOUNDATION INVESTIGATIONS NASA MISSISSIPPI TEST FACILITY. REPORT 2: STATIC LOAD TESTING OF FOUNDATION PILES AT TEST STAND S-II, AL
John B. Stevens, Jack Fowler, and Robert G. Guernsey Jun. 1970 42 p Sponsored by NASA
(NASA-CR-114265; AD-708553; S-69-10) Avail: NTIS CSCL 13M

The Mississippi Test Facility, located approximately 50 miles northeast of New Orleans, Louisiana, is the site for test firing the first and second stages of the Saturn 5 rocket. Strain gages were installed on two test piles that were driven before excavation for the test stand foundations to determine the required length of piling. The test piles were driven through casings installed to the approximate subgrade elevation to eliminate frictional effects of soil that would later be excavated. This report describes instrumentation placed on the test piles, presents strain gage readings made during 186- and 300-ton load tests, and presents strain gage readings made before the load tests and after excavation at the S-2, AL test stand. Pile driving data together with boring logs and logs of split-spoon sample borings are also presented.
Author (TAB)

N70-42325*# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
FOUNDATION INVESTIGATIONS NASA MISSISSIPPI TEST FACILITY. REPORT 3: LOAD TRANSFER BY FOUNDATIONS OF S-IC AND S-II TEST COMPLEXES DURING CONSTRUCTION
Jack Fowler and John B. Stevens Jun. 1970 132 p refs Sponsored by NASA
(NASA-CR-114269; AD-708554; S-69-10) Avail: NTIS CSCL 13M

The Mississippi Test Facility, located in southwest Mississippi, is the site for test firing of the first and second stages of the Saturn 5 boosters. At the request of the U. S. Army Engineer District, Mobile, plans were developed for instrumenting the test stands to obtain data on foundation base pressures, lateral wall pressures, and pile loads during construction. Soils beneath the S-1C test stand consist of 36 ft of brown fat clay underlain by dense, poorly graded sands. To support the structure, 1640 vertical and battered H piles were driven through the clay into the dense sand. Stress meters were installed beneath the foundation to measure base pressures, and on the walls to measure wall loads. Stress meters and pore pressure cells were installed beneath the S-2 stand. Strain gages were mounted on 40 piles of the 588 used.
Author (TAB)

N70-42328 Georgia Inst. of Tech., Atlanta.
THE STRUCTURAL EFFECTS OF CYCLIC THERMAL LOADING ON A FREE ELASTOPLASTIC PLATE
Gerald Ware May (Ph.D. Thesis) 1969 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-22599.

The principal objects were to investigate the structural behavior of a free, elastic-perfectly plastic plate subjected to cyclic thermal loading on its surfaces and to develop a method of predicting the resulting behavior. The study concludes that a free plate can either deform elastically, shakedown to an elastic state, yield in an alternate plasticity mode of behavior, or yield in an incremental collapse mode of behavior when subjected to cyclic thermal loading. A method of predicting which mode of behavior will result for any given heating condition was formulated. Details of the predictor procedure are presented for the special case of a linearly varying surface temperature.
Dissert. Abs

N70-42391 National Lending Library for Science and Technology, Boston Spa (England).
THERMAL STRESSES IN A SHALLOW SPHERICAL SHELL UNDER AXISYMMETRICAL HEATING [TEMPERATURNYE NAPRYAZHENIYA V POLOGOI SFERICHESKOI OBOLOCHKE PRI OSESIMMETRICHNOM NAGREVE]
V. D. Afinogenov Jul. 1970 6 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mat. i Mekhan. (Moscow), v.1

1968 p 114–118
(NLL-RTS-5888) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s; 2 NLL photocopy coupons

The state of stress and strain in spherical shells is studied. Formulas are obtained for the strains and internal force factors in the case of a quadratic temperature distribution along the meridian. Author

N70-42395*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRESS INTENSITY MAGNIFICATION FOR DEEP SURFACE CRACKS IN SHEETS AND PLATES
Robert B. Anderson, Arthur G. Holms, and Thomas W. Orange Washington Oct. 1970 53 p refs
(NASA-TN-D-6054; E-5708) Avail: NTIS CSCL 20K

The Irwin stress intensity factor for surface cracks with crack depths less than half the plate thickness is extended to cases of relatively deep cracks by including the effect of the free surface opposite the crack. The stress intensity magnification factor is given as a function of applied load, crack length, crack depth, sheet thickness, yield strength, and Poisson's ratio. The combinations of these variables, for which the plastic zone extends completely through the thickness are also predicted. The range of applicability of the analysis to surface-crack specimen data was investigated in terms of crack-depth-to-specimen-thickness ratio and crack depth-to-length ratio. Author

N70-42434# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Muelheim (West Germany). Inst. fuer Festigkeit.
INVESTIGATIONS ON THE DYNAMIC STABILITY OF CYLINDRICAL SHELLS UNDER AXIAL IMPACT [UNTERSUCHUNGEN UEBER DIE DYNAMISCHE STABILITAET AXIAL GESTOSSENER ZYLINDERSCHALEN]
Horst Schwieger and Christian Spuida Jun. 1970 112 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-19) Avail: NTIS; ZLDI Munich: 29,50 DM

Small and large shells were used to investigate the interaction between the striking body and the shell e.g. impact forces, contact times, displacements, etc. All shells had a shell radius/wall thickness ratio of 500. Buckling phenomena were visualized and photographed at 8,000 frames/sec. The experimental results were compared with theoretical values. Author (ESRO)

N70-42450 Cincinnati Univ., Ohio.
DYNAMIC ANALYSIS OF COMPLEX SPACE STRUCTURES
Victor Thomas Nicolas, Jr. (Ph.D. Thesis) 1969 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 70-451

A finite element method is presented for the dynamic analysis of linear, elastic space structures composed of plate and beam type members. The beam members can be curved and nonuniform and can be attached to plate elements and other beam members with rigid, pinned or sliding connections. A combined transfer-stiffness matrix method is employed to reduce the size of the dynamic stiffness matrix for the overall structure to a manageable size for the determination of natural frequencies and forced response of the structure. In the course of the development, a new rectangular finite plate element is introduced that contains an in-plane rotational degree of freedom which makes the plate element fully compatible with space beam finite element models. Numerical examples and test results are presented. Dissert. Abstr.

N70-42472 Virginia Polytechnic Inst., Blacksburg.
FRACTURE OF CENTRALLY CRACKED PLATES UNDER COMBINED BENDING AND EXTENSIONAL LOADING
Robert Hugh Wynn (Ph.D. Thesis) 1969 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-16264

An experimental and theoretical study of a fracture criterion was made. Existing bending and extension theories were studied and existing fracture criteria for combined loading were compared to the results of the experimental investigation of Plexiglas. A criterion based on a strain energy release rate concept was proposed using the sixth-order bending theory modified for precatastrophic crack growth. The suggested criterion, which was determined by integrating the strain energy release rate for the combined problem through the thickness and equating it to the same value for the extensional case, was found to be in good agreement with experimental tests on Plexiglas for the region in which the crack is open at fracture. In the region where the crack is closed at fracture, the suggested criterion appears to be a conservative lower bound. Dissert. Abstr.

N70-42506# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE DAMPED NORMAL MODES OF ENCASTRE SANDWICH BEAMS WITH VISCO-ELASTIC CORES
D. J. Mead and S. Markus Jul. 1969 46 p refs
(ISVR-TR-24) Avail: NTIS

The differential equation for the damped normal modes of a three-layer encastre sandwich beam was used with appropriate boundary conditions to determine the characteristic equation for the resonant frequency, loss factor, and modal roots. An iterative method of solving this equation is presented, and computed values for a wide range of parameter values are given. The six modal roots are critically examined: all of them have both real and imaginary parts implying that beams with different boundary conditions have different loss-factor/resonant frequency relationships. Author (ESRO)

N70-42519*# Bellcomm, Inc., Washington, D.C.
REVIEW OF MODAL SYNTHESIS TECHNIQUES AND A NEW APPROACH
S. N. Hou 26 Sep. 1969 30 p refs
(Contract NASw-417)
(NASA-CR-110729; TM-69-2031-5) Avail: NTIS CSCL 20K

Modal synthesis is a technique of determining mode shapes and frequencies of a large discrete mass dynamic system by breaking the system into parts, analyzing the parts, and reassembling the total system using selected modal information from the parts. An interpretive review is given of the state-of-art in both research and aerospace applications. Based on these studies, an approach is proposed that emphasizes ease of interpretation, mathematical simplicity, accuracy of results, and computer capability. This method can yield a spectrum of system normal frequencies in the range of interest and associated mode shapes. Actual boundaries are imposed between parts, using either rigid body and free-free elastic modes or only constrained elastic modes of the parts. Compatibility and equilibrium at boundaries are satisfied for modal coupling. A simple error control scheme based on convergence of eigenvalues of the total system is used to ensure adequate selection of modes from the parts. Author

N70-42537 National Lending Library for Science and Technology, Boston Spa (England).
ON THE PROBLEM OF THE PRACTICAL CALCULATION OF DEFORMING MOMENTS OF A SHELL ON A RECTANGULAR PLANE [K VOPROSU O PRAKTISCHESKOM VYCHISLENII IZIGIBAYUSHCHIKH MOMENTOV OBOLOCHEK NA PRYAMOUGOLNOM PLANE]
M. Mishonov Jun. 1970 14 p refs Transl. into ENGLISH from Inzh. Sb. (Moscow), no. 27, 1960 p 162–170
(NLL-RTS-5787) Avail: Natl. Lending Library, Boston Spa, Engl.: 26s; 4 NLL photocopy coupons

Mathematical expression are given for calculating the deforming moments of a shell with constant principal curvatures supported

along contours which are lines of the curvatures. A differential equation of a beam on an elastic foundation with non-zero free term is obtained. Shells freely supported and rigidly clamped are considered. N.E.N.

N70-42564# Laval Univ. (Quebec).
FINITE DIFFERENCE SOLUTION OF VLASOV'S GENERAL THIN SHELL EQUATIONS
L. Lachance and M. Tremblay [1969] 25 p refs Presented at 2d Can. Congr. of Appl. Mech., Waterloo, Quebec, 20 - 23 May 1969 Supported by NRC of Can.
Avail: NTIS

Vlasov's general equations for any shell of small thickness are formulated in terms of the three functions u, v and w and their partial derivatives. These functions define the vector of complete displacement of a point on the middle surface of the shell. By means of finite differences, the partial differential equations are transformed into finite difference equations. The surface of the shell to be analyzed is divided into a convenient network and the general finite difference equations are applied to each point of the grid. The boundary conditions are then expressed in finite difference form and a set of n equations and n unknowns are obtained. Using a computer, the matrix is solved by Gaussian elimination to determine the displacements u, v and w, and the resulting forces and moments corresponding to the applied loads. Author

N70-42570 City Univ. of New York.
ANALYTICAL INVESTIGATION OF WAVE PROPAGATION AND REFLECTIONS IN TIMOSHENKO BEAMS
Joel Marc Garrelick (Ph.D. Thesis) 1969 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm: $3.00 Order No. 69-19058

The dynamic response of Timoshenko beams under transverse impact is studied theoretically with particular emphasis on discontinuities and their propagation. The standard eigenfunction solution to the finite simply supported span subjected to a uniform velocity input is modified by isolating the leading discontinuities into a progressing wave expansion, resulting in improved convergence properties. Methods are developed for obtaining the leading reflected discontinuities for a general mixed boundary value problem involving the Timoshenko equations. Asymptotic results for large slenderness ratios and times are obtained in the vicinity of the wave fronts by stationary phase and singular perturbation analyses. Qualitative effects of Maxwell and Kelvin damping of the spring supports and in the material are shown. The applicability of the elementary Euler Bernoulli theory to the analysis of the above problems is discussed. Dissert. Abstr.

N70-42572# National Aerospace Lab., Amsterdam (Netherlands).
THE EFFECT OF SECONDARY BENDING ON THE FATIGUE STRENGTH OF 2024-T3 ALCLAD RIVETED JOINTS
A. Hartman and J. Schijve Dec. 1969 47 p refs Sponsored by Neth. Aircraft Develop. Board
(NLR-TR-69116-U) Avail: NTIS

Six types of riveted specimens, including lap joints and single and double strap joints, were compared in constant-load-amplitude and program tests. In the program tests, based on a gust load spectrum, the double strap joints lasted about three times as long as the single lap and single strap joints with low secondary bending stresses, and about ten times as long as joints with severe secondary bending stresses. The fatigue strength for N = 10 million load cycles decreased by severe secondary bending in the specimens to about half the strength of the double strap joints. The relation between the calculated bending stresses and the fatigue strength was analyzed for design purposes. Author (ESRO)

N70-42573*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A LIMITED STUDY OF THE APPLICATION OF CONCENTRATED LOADS TO FIXED EDGE AND DISCONTINUOUS TWO-WAY SLABS OF REINFORCED CONCRETE, USING THE CENTRAL DIFFERENCE OPERATOR OF THE FINITE DIFFERENCE APPROXIMATION TO THE BIHARMONIC EQUATION
Ronnie R. Henk (M.S. Thesis - Va. Polytech. Inst.) Jun. 197[illegible] 84 p refs
(NASA-TM-X-66392) Avail: NTIS CSCL 20K

A comparison of resulting design moments for a particular size, uniformly loaded, two-way reinforced concrete slab with various boundary conditions is presented, using both the central difference operator of the finite difference approximation to the biharmonic equation and method 3 of ACI Bulletin 318-63. To determine whether the large grid finite difference analysis would reasonably approximate the results of ACI 318-63 method 3 for a uniformly loaded slab was attempted. Due to the reasonably close correlation of the results of the two methods of finite difference analysis, with the aid of the elastic curve plot, was used to determine the design moments of the slab under the influence of a concentrated load. A concentrated load in finite difference analysis is defined as being uniformly distributed over an equivalent grid area, with the center of the loaded area and the loaded grid point being coincident. Author

N70-42604# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
EXPERIMENTAL STUDY OF LONG CYLINDRICAL SHELL UNDER CONCENTRATED LOADS APPLIED TO A CENTRAL REINFORCING RING
Arnold Allentuch, Kevin Brady, Eugene Golub, and Joseph Kempner May 1970 33 p refs
(Contract F44620-69-C-0072)
(AD-710205; PIBAL-70-21; AFOSR-70-1786TR) Avail: NTIS CSCL 13/13

The stresses and displacements are determined experimentally in a long circular cylindrical shell reinforced at its midlength by a single uniform ring. Acting at the ends of a diameter of the ring are two self-equilibrating outward radial forces. The experimental results are compared to analytical results previously obtained using the Donnell shell differential equations. Good agreement is observed between theory and experiment for both the displacements and the stresses. The theory predicts and the experiments corroborate that the maximum displacement of the cylinder does not occur under the ring. Both theory and experiment also reveal that the eccentricity between the ring median radius and the shell radius has a first order effect on the stresses in and displacements of the shell. Author (TAB)

N70-42607# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
STRESSES IN AN ASYMMETRICALLY LOADED SHALLOW SPHERICAL MEMBRANE SHELL
Richard Mondello and Martin A. Goldberg Apr. 1970 74 p refs
(Contract F44620-69-C-0072)
(AD-710204; PIBAL-70-19; AFOSR-70-1587TR) Avail: NTIS CSCL 13/13

A technique is developed for evaluating the stress distribution in a thin-walled shallow, elastic, spherical membrane which contains either an eccentric aperture and symmetric load or a polar aperture and eccentrically located concentrated load. The aperture is circular in all cases. A catalogue of examples is presented which includes a uniformly pressurized spherical cap having a stress free non-polar opening; a spherical segment with an off-center aperture subjected to uniform shear along its internal boundary; and a shallow spherical annulus subjected to an eccentrically located concentrated radial load, torque, shear, and moment. Wherever possible, the internal boundary of the annulus is rendered stress free. Where this cannot be accomplished the condition that the radial stress vanish at the aperture edge is imposed. No boundary conditions are prescribed

at the outer edge. Numerical computations have been carried out for all examples treated, and are summarized in a series of graphs. Author (TAB)

N70-42631*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELAS: A GENERAL-PURPOSE COMPUTER PROGRAM FOR THE EQUILIBRIUM PROBLEMS OF LINEAR STRUCTURES. VOLUME 2: DOCUMENTATION OF THE PROGRAM
Senol Utku 15 Sep. 1969 30 p refs
(Contract NAS7-100)
(NASA-CR-110784; JPL-TR-32-1240) Avail: NTIS CSCL 20K

A general purpose digital computer program for the in-core solution of linear equilibrium problems of structural mechanics is described. The program requires minimum input for description of the problem. The solution is obtained by the displacement method and the finite element technique. Almost any geometry and structure may be handled because of the availability of lineal, triangular, quadrilateral, tetrahedral, hexahedral, conical, triangular torus, and quadrilateral torus elements. The assumption of piecewise linear deflection distribution insures monotonic convergence of the deflections from the stiffer side with decreasing mesh size. The stresses are provided by the best-fit strain tensors in the least-squares sense at the mesh points where the deflections are given. The selection of local coordinate systems whenever necessary is automatic. The core memory is efficiently used by means of dynamic memory allocation, an optional mesh-point relabelling scheme, imposition of the boundary conditions during the assembly time, and the straight-line storage of the rows of the stiffness matrix within variable bandwidth and the main diagonal. Author

N70-42696*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERMANENT IMPACT DEFORMATION OF SPHERICAL SHELLS
Richard E. Morris Washington Oct. 1970 15 p refs
(NASA-TM-X-2067; E-5589) Avail: NTIS CSCL 20K

Published experimental data were analyzed using dimensional analysis to obtain an empirical correlation equation for the impact deformation of spherical shells. The correlation equation obtained shows that the deformation to mean radius ratio is proportional to the square root of the shell density, to the 1.0 power of velocity, to the -0.5 power of ultimate stress, to the 0.08 power of the shell radius, and to the -0.08 power of the wall thickness. This correlation, which is based on sphere impact data obtained from shells 3/4 to 4 in. in diameter, was used to calculate the impact-deformation behavior of a 17 ft diameter spherical containment vessel for a nuclear reactor. The predicted deformation for an impact velocity of 900 ft/sec was about 7 ft. Author

N70-42736*# Texas A&M Univ., College Station. Remote Sensing Center.
INFRARED DETECTION OF CONCRETE DETERIORATION
R. H. Arnold, H. L. Furr, and J. W. Rouse, Jr. Jul. 1969 21 p
(Grant NGL-44-001-001)
(NASA-CR-110869; RSC-02) Avail: NTIS CSCL 13M

Results of a preliminary experiment to ascertain the feasibility of determining concrete deterioration by measuring thermal emissivity in the 2 to 5 micron region are presented. The tests show the existence of emissive differences related to certain deterioration conditions. Delaminations were detectable using an infrared scanner. They were most noticable during ambient cooling periods during heat transfer from the specimens. Experimental data indicates a need for supporting information of surface temperature and radiometric measurements during the entire heat exchange intervals. Author

N70-42802# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
TORSION TESTING USING A DIGITAL COMPUTER
M. W. Peore and J. H. Smith 17 Jul. 1970 36 p refs
(Contract W-7405-eng-26)
(Y-1731) Avail: NTIS

A digital computer can be used for acquiring and reducing data on torsion tests. The torque and strain signals are fed through an analog-digital converter to a small processor computer where the data are stored, assembled, and reduced. A printout and punched tape are obtained which contain the shear properties and the associated stress-strain data points. Author (NSA)

N70-42844# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
THEORY AND STRUCTURAL DESIGN APPLICATIONS OF WEIBULL STATISTICS
G. J. De Salvo [1970] 104 p refs
(WANL-TME-2688) Avail: NTIS

The basic theory of Weibull statistics and its application to structural design are described. Included is a description of the Weibull parameters and their effects on design considerations. Several methods of reducing fracture data to obtain the Weibull parameters are described and compared. The size and stress distribution effects predicted by Weibull's theory are presented in detail along with working curves which may be used in design. Relationships between reliability and safety factor and methods of determining allowable material strengths are presented. Several example problems illustrating the use of Weibull statistics in design considerations are also included. Author (NSA)

N70-42934* National Aeronautics and Space Administration, Washington, D.C.
THE NASTRAN THEORETICAL MANUAL
Richard H. Mac Neal, ed. Sep. 1970 480 p refs
(NASA-SP-221) Avail: COSMIC

NASTRAN, which is defined as a finite element computer program for structural analysis intended for every kind of structure and almost every type of construction, is presented. The range of analysis includes: static response to concentrated and distributed loads, to thermal expansion and to enforced deformation; dynamic response to transient loads, to steady-state sinusoidal loads and to random excitation; determination of real and complex eigenvalues for use in vibration analysis. It was designed to treat large problems with many degrees of freedom. Static structural, elastic stability, dynamic structural, and general matrix problems can be solved by NASTRAN. F.O.S.

N70-42975# Naval Postgraduate School, Monterey, Calif.
A DIGITAL COMPUTER STUDY OF THE BUCKLING OF SHALLOW SPHERICAL CAPS AND TRUNCATED HEMISPHERES
William Carter Stilwell (M.S. Thesis) Jun. 1970 78 p refs
(AD-709921) Avail: NTIS CSCL 20/11

A study of the buckling of thin shells was conducted using a digital computer program for the geometrically nonlinear analysis of arbitrarily loaded shells of revolution. The objective was an evaluation of the programs applicability to bifurcation buckling and imperfection sensitivity analysis. Clamped spherical caps under pressure loading and clamped truncated hemispheres under axial tension were investigated. Buckling loads were determined for axisymmetric and nearly axisymmetric loads and are compared with previously published theoretical and experimental results. The sensitivity of the loaded shells to imperfections in load was determined and is compared with previously published analytical results based on geometric imperfections. Author (TAB)

N70-43026# Glasgow Univ. (Scotland). Dept. of Aeronautics and Fluid Mechanics.
STRUCTURAL CONSIDERATIONS OF FILAMENT WOUND CYLINDRICAL SHELLS

H. Y. Wong Nov. 1968 39 p refs
(Rept-6804) Avail: NTIS

The structural response of filament wound cylindrical shells to a combination of applied loadings is investigated. In many cases the membrane theory forms an adequate basis for the analysis. By suitable arrangement of the filament orientations and layer thicknesses, an efficient structure can be achieved. Numerical examples are given to show their influence on the stress components. The strength of the shells can be judged according to some criterion. The determination of the elastic constants is also given. Author

N70-43044*# Massachusetts Inst. of Tech., Cambridge.
ANALYSIS OF FOLDING OF BLADDER STRUCTURES
L. L. Bucciarelli, Jr. and V. K. Agarwal 15 Aug. 1970 37 p refs Prepared for JPL
(Contract NAS7-731)
(NASA-CR-110934; ASRL-TR-160-1) Avail: NTIS CSCL 20K

The large, axisymmetrically deformed state of a constrained spherical shell under external pressure is determined. Results show that there exists a narrow zone along the meridional wherein extreme stress levels are attained. It is postulated that when wrinkling (asymmetric deformation) initiates, it does so within this zone. These results provide insight into the collapse mechanism of propellant expulsion bladders and diaphragms in the form of shells of revolution. Author

N70-43052# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE VIBRATION OF SHALLOW SHELLS HAVING POINT SUPPORTS
Paul J. Nemergut Jul. 1970 27 p ref
(AD-710208; AFIT-TR-70-2) Avail: NTIS CSCL 13/13

The report presents a method of analyzing a simply supported thin shallow shell with a point support located interior to the boundary. The problem reduces to finding a stress function from which all quantities may be determined. Application of the boundary and continuity conditions gives the sixteen necessary equations for solution. A numerical procedure is presented which involves the inversion of a 16 x 16 matrix. Author (TAB)

N70-43114# Naval Civil Engineering Lab., Port Hueneme, Calif.
THE SPHERICAL ACRYLIC PRESSURE HULL FOR HYDROSPACE APPLICATIONS. PART 3: COMPARISON OF EXPERIMENTAL AND ANALYTICAL STRESS EVALUATIONS FOR PROTOTYPE NEMO CAPSULE Final Technical Report, Feb. - Mar. 1970
Henning Ottsen Mar. 1970 25 p refs
(AD-709914; NCEL-TN-1094-Pt-3) Avail: NTIS CSCL 13/10

A comparison is presented of results obtained from analytical and experimental stress analyses of the NEMO pressure hull (an acrylic submersible with steel polar penetrations). The general procedures of the analytical investigation are reviewed and the assumptions stated. Excellent agreement between the two sets of results was observed for the acrylic portion of the hull. Due to the severe structural simplification necessary in the analytical simulation of the steel polar penetrations, discrepancies were noted in the two sets of stresses obtained in these regions; general trends were, however, similar. It was concluded that the acrylic to steel transitions incorporated in the prototype design provide an optimum transfer of load without inducing a concentration of stresses. Author (TAB)

N70-43145* Maryland Univ., College Park. Dept. of Mechanical Engineering.
DYNAMIC RESPONSE OF SEMI-INFINITE CONCENTRIC ELASTIC CYLINDERS IN A SEMI-INFINITE ACOUSTIC MEDIUM
Robert Franklin Carpenter, III (Ph.D. Thesis) 1970 112 p refs
Avail: NTIS

The dynamic response of semi-infinite concentric elastic cylinders in a semi-infinite acoustic medium is presented. The Fourier-Laplace transforms of the Love-Timoshenko shell equations are taken with respect to the axial spatial variable and the time variable. The finite Hankel-Fourier-Laplace transform of the equation describing the motion of a viscous acoustic field under an initial pressure contained in a cylindrical shell is taken with respect to the spatial variable, the radial spatial variable, and time. Author

N70-43181 National Lending Library for Science and Technology, Boston Spa (England).
THE AVERAGE FLEXURE OF A GENTLY SPHERICAL PANEL WHICH IS SQUARE IN PLAN VIEW, WITH NON-LINEAR RELATIONSHIP BETWEEN THE DEFORMATION AND THE STRESS [SREDNII IZGIB POLOGOI SFERICHESKOI PANELI, KVADRATNOI V PLANE, PRI NELINEINOI ZAVISIMOSTI MEZHDU DEFORMATSIEI I NAPRYAZHENIEM]
Kh. M. Mushtari et al Jun. 1970 7 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. Tekh. Fiz. (Moscow), v. 2, 1960 p 162-165
(NLL-RTS-5786) Avail: Natl. Lending Library, Boston Spa, Engl. 12s; 2 NLL photocopy coupons

Numerical data were obtained and computed for the flexure of a spherical plate; square in plane view, with an external normal pressure load; which was resting on ribs flexible in their own plane; and had a nonlinear relation between deformation and stress. The coefficient of transverse compression was assumed to vary as a function of deformation according to the square parabola law. Simplified expressions for elastic forces and moments, and parameters of middle surface flexure variation are given. Homogeneous linear and quadratic functions as well as Bubnov-Galerkin integration, membrane stress, and flexural stresses in upper and lower fibers are included. It is concluded that the presence of slight physical nonlinearities in the material reduces the transverse pressure and the total stress corresponding to the particular deflection. Transverse pressure reductions were up to 10% in the examples presented with decreases of total stress up to 25%. J.M.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N70-41833# Gulf General Atomic, San Diego, Calif.
TAC3D: A GENERAL PURPOSE THREE DIMENSIONAL HEAT TRANSFER COMPUTER CODE: MATHEMATICAL FORMULATIONS AND PROGRAMMER'S GUIDE
S. S. Clark, J. V. Del Bene, and J. F. Peterson Sep. 1969 242 p refs
Contract AT(04-3)-167)
(GA-9264) Avail: NTIS

TAC3D is a code for calculating steady-state and transient temperatures in three-dimensional problems by the finite difference method. It is written entirely in Fortran 5. The configuration of the body to be analyzed is described in the rectangular or cylindrical coordinate system by orthogonal planes of constant coordinate called grid planes. The grid planes specify an array of nodal elements. Nodal points are defined as lying midway between the bounding grid planes of these elements. A finite difference equation is formulated for each nodal point in terms of its capacitance, heat generation and heat flow paths to neighboring nodal points. A system of these equations is solved by an implicit method which is one of the most efficient known at this time. Author (NSA)

N70-41859# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton.
HEAT TRANSFER AND PRESSURE DROP FOR FORCED FLOW OF PRESSURIZED LIQUID HELIUM AND TWO-PHASE HELIUM IN TUBES
B. Colyer Mar. 1970 31 p refs
(RHEL/R-193) Avail: HMSO 5s; BIS $1.00

Equations are derived for heat transfer and pressure drop for forced flow of single-phase and two-phase helium in tubes. For a given tube, under certain conditions, it is shown that there exist maximum and optimum mass flow rates. Tables of certain functions required for calculation are given. Author (NSA)

N70-42023*# Aerotherm Corp., Mountain View, Calif.
A COUPLED COMPUTER CODE FOR THE TRANSIENT THERMAL RESPONSE AND ABLATION OF NON-CHARRING HEAT SHIELDS AND NOSE TIPS
Carl B. Moyer, Larry W. Anderson, and Thomas J. Dahm Washington NASA Oct. 1970 108 p refs
(Contract NAS1-8501)
(NASA-CR-1630; Rept-69-60) Avail: NTIS CSCL 20M

The controlling subcode is the in-depth transient heat conduction routine; it treats two dimensional axisymmetric bodies using the explicit finite difference method. It is coupled to a completely general thermochemistry subcode for the surface state and ablation computation. This routine allows for full equilibrium considering a large number of species, and can also account for any number of nonequilibrium effects. The code also features automatic coupled calculations of the pressure around the body, using a variation of modified Newtonian relations coupled to Prandtl-Meyer expansions. The subsonic region pressure description includes empirical corrections necessary on very blunt bodies. In addition, the code automatically computes the boundary layer edge static enthalpy, the recovery enthalpy, and the convective transfer coefficient, employing appropriate computed property values for any edge gas. Author

N70-42078# Scientific Translation Service, Ann Arbor, Mich.
HEAT EXCHANGER WITH FLAT TUBES AND CONTINUOUS FINS
Helmut Theil et al Jun. 1970 14 p refs Transl. into ENGLISH from Timisoara Tech. Univ. Rept., 1970 Prepared for Argonne Natl. Lab., Ill.
(ANL-Trans-835) Avail: NTIS

The heat transfer and air resistance of 24 heat exchangers with flat tubes and continuous fins were investigated for the water-air material couple in a wind tunnel. The influence of the following variables was investigaged: air and water inlet temperature, air and water flow rate, number of tube rows (z = 2, 3, 4), tube configuration (aligned, staggered), fin spacing (t = 2, 3, 3.5, 4 mm), and fin material (copper, brass, steel sheet). The thermal conductivity coefficient and heat transfer coefficient on the air side were determined by calculation. Author

N70-42111# Scientific Translation Service, Ann Arbor, Mich.
INFLUENCE OF THERMAL CONDUCTION ON THE EFFICIENCY OF A REGENERATOR WITH A MOVING ACCUMULATOR PACKING [DER EINFLUSS DER WARMLEITUNG AUF DEN WIRKUNGSGRAD EINES REGENERATORS MIT BEWEGTER SPEICHERMASSE]
Helmuth Glaser Jun. 1970 13 p refs Transl. into ENGLISH from Stuttgart Univ. Rept., 1970 Prepared for Argonne Natl. Lab., Ill.
(ANL-Trans-837) Avail: NTIS

For the case of the frequently used spherical accumulator packing, the temperature curve is calculated within the pebbles and this serves to determine their mean temperature which lags behind the surface temperature by a certain amount. The value of a coefficient of thermal conductivity is then determined by means of which the heat transferred by the regenerator can be calculated in the same manner as in a counter-current heat exchanger. Finally, a relation is developed for the efficiency of the unit. This relation depends on two dimensionless quantities which characterize the heat transfer conditions. A diagram permits a rapid determination of the efficiency. Author

N70-42112# Michigan State Univ., East Lansing. Dept. of Chemistry.
VAPORIZATION THERMODYNAMICS OF SAMARIUM OXIDE FLUORIDE
Harry A. Eick and Dale E. Work [1970] 16 p refs Supported in part by NSF
(Contract AT(11-1)-716)
(COO-716-57) Avail: NTIS

Samarium oxide fluoride was studied at high temperatures by X-ray diffraction and target collection Knudsen effusion techniques and found to vaporize over the temperature range 1614 to 2017 K to the sesquioxide and gaseous trifluoride. Second- and third-law vaporization enthalpies are discussed. Author

N70-42113# Grumman Aerospace Corp., Bethpage, N.Y. Fluid Mechanics Section.
EXPLORATORY TESTS USING TEMPERATURE-SENSITIVE PAINTS TO OBTAIN HYPERSONIC HEAT TRANSFER DATA ON SPHERES AND ON FIN-PLATE MODELS
Louis G. Kaufman, II, Jarvis Leng, and Arnold R. Johnson Sep. 1970 44 p refs
(RN-487) Avail: NTIS

Paints that melt at a known temperature were sprayed on Teflon models, which were tested in a Mach 8 wind tunnel. The propagation of the melt line, recorded by motion picture cameras, was used to calculate heating rate distributions. These generally agreed with theoretical heating rate distributions for hemispheres, and gave results in fair agreement with other fin-plate experimental results. The paint indicated quite well the location of maximum heating at shock impingement; the accuracy of the peak heating rate depended on its magnitude and on the phase change temperature paint chosen. Author

N70-42177# Los Alamos Scientific Lab., N.Mex.
DEPENDENCE OF CRITICAL DIAMETER OF LIQUID EXPLOSIVES ON CONTENT OF POWDERS
R. Kh. Kurbangalina Mar. 1970 8 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 4, 1969 p 133-136
(LA-tr-70-8) Avail: NTIS

Results are given for an experimental study of the dependence of the critical diameter (d^*) of nitromethane (NM) on the content of powders of aluminum, aluminum oxide, tungsten, carbon black, and talc and on the diameter of tetranitromethane (TNM) on the content of aluminum and aluminum oxide. The content and degree of dispersion of the powders were varied over a wide range. It was established that the nature of the change in d^* for mixtures of NM differs sharply from the nature of the change in d^* for mixtures of TNM. When the particle size of the powder is within limits of 1 to 50 microns, the value of d^* for NM mixtures decreases with the increase in powder concentration. The minimum value of d^* is smaller than the value of d^* for pure NM by a factor of 10. In TNM mixtures, d^* increases monotonically with the increase in the amount of powder. It is assumed that such a behavior in NM mixtures is related to the inhomogenity in the structure of the detonation wave front in NM, which is caused by the peculiarity in the kinetics of the chemical conversion of NM. Author

N70-42180*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
SCALING PARAMETERS FOR THE SIMULATION OF

HIGHLY EXPANDED ROCKET EXHAUST PLUMES AND THE RESULTANT IMPINGEMENT FORCES ON AN IMMERSED BODY

J. T. Stephens Jul. 1970 199 p refs
(Contract NAS8-24437)
(NASA-CR-102853; HREC-4437-1; LMSC/HREC-D162424) Avail: NTIS CSCL 21B

Literature dealing with the proper scaling of rocket exhaust plumes with nonreacting gas mixtures is reviewed. From this background, a technique was developed to select gases which will properly simulate a region of a prototype plume. A gas simulant selection computer program is then presented and results of this program for two typical engines are discussed. A specific parameter of a region of a prototype plume can, in general, be simulated. In particular, the momentum flux of a plume can be easily duplicated for a definite region of a plume. Typical selections resulted in about a three percent error in momentum flux. In addition, the Mach number can be simulated by adjusting gas composition and chamber temperature. Author

N70-42187 National Lending Library for Science and Technology, Boston Spa (England).

RADIATION MEASUREMENTS ON ELECTRICALLY HEATED SiC RODS

W. Bruegel 8 Jun. 1970 8 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 127, 1950 p 400–404
(NLL-LB/9/2866-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The emissivity of electrically heated SiC rods (infrared sources) was compared experimentally with that of a black body in the range 0.6 to 15 micron at a temperature of 1243 K, and the ratio E sub r of the two emissivities measured. The temperature-dependence of E sub r was calculated from experimentally obtained isochromatic lines. Author

N70-42194# Scientific Translation Service, Ann Arbor, Mich.

HEAT TRANSFER IN REGENERATORS [WARMEABZRGANG IN REGENERATOREN]

Sergei Traustel Jun. 1970 8 p refs Transl. into ENGLISH from Tech. Univ. Brunswick Rept., 1970 Prepared for Argonne Natl. Lab., Ill.
(ANL-Trans-838) Avail: NTIS

A simplified calculating procedure is developed for heat transfer in regenerators based on calculations made of recuperators. The simplification is obtained only partly at the expense of accuracy. For the other part it is obtained by the introduction of suitable dimensionless quantities. Author

N70-42288# Naval Weapons Station, Yorktown, Va.

DEVELOPMENT AND TESTING OF THE HYDRO-ADIABATIC DETONATOR

E. Yancey McGann 31 Jul. 1970 24 p refs
(AD-709560; NWSY-TR-70-4) Avail: NTIS CSCL 19/1

The report describes the work conducted to develop a simple explosive device to replace present complicated arming and firing mechanisms used in underwater sound signals. This device contains no primary explosive and represents a significant improvement in the design and safety of explosive devices. Potential applications are not limited to underwater sound signals. Author (TAB)

N70-42291*# TRW Systems Group, Houston, Tex.

SUBSYSTEMS TEST BED THERMAL MATHEMATICAL MODEL CORRELATION

T. B. Mobley, J. P. Smith, and R. E. Seward 29 Jun. 1970 258 p refs
(Contract NAS9-9392)
(NASA-CR-108627; TRW-12245-H003-R0-00) Avail: NTIS CSCL 20M

The subsystems test bed (STB) thermal mathematical models (TMM's) were correlated with the data obtained during the STB thermal vacuum testing. The test was conducted in Chamber A of the Space Environment Simulation Laboratory (SESL) located at NASA/MSC. The test period consisted of 170 hours of real time testing performed between March 16 and March 23, 1970. The STB TTM, a more detailed TMM of a quarter section of the STB, and a standoff TMM were used in the analysis. Comparison curves for representative thermocouples (T/C), as well as comparative cabin temperature distributions are presented for each test phase. Ninety percent of the calculated temperatures were within 10 F of their corresponding T/C readings. In addition, the results of a comparative analysis between a STB TMM with a multilayer insulation (MLI) linear conductance and a STB TMM with a nonlinear conductance calculated with an effective MLI emissivity are included. Author

N70-42326*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

THERMAL FEASIBILITY OF USING METHANE OR HYDROGEN FUEL FOR DIRECT COOLING OF A FIRST-STAGE TURBINE STATOR

Raymond S. Colladay Washington Oct. 1970 25 p refs
(NASA-TN-D-6042; E-5701) Avail: NTIS CSCL 20M

The feasibility of cooling the first-stage turbine stator directly with cryogenic fuels was investigated based on a numerical heat transfer analysis of methane and hydrogen-cooled vanes. An insulation barrier between the fuel cooling passages and the external vane surface was required to prevent adverse cooling conditions. The cooling configuration analyzed was that of tubular cooling passages embedded in insulation material surrounded by an outer vane shell. The results indicate that the turbine stator vanes could be adequately cooled with methane or hydrogen fuel at a 2490 F (1639 K) local-hot-spot gas temperature. Author

N70-42332 Carnegie-Mellon Univ., Pittsburgh, Pa.

A THEORETICAL STUDY OF THE PHENOMENA ASSOCIATED WITH THE IMPINGEMENT OF A LIQUID DROP ON A HOT SURFACE

Frederick David Lawrence (Ph.D. Thesis) 1969 162 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-19101

An analytical study is made of the problem of a liquid drop impinging upon a high-temperature surface. The mathematical model of the process is based on representation of the drop by a deformable, circular cylinder. The governing equations for the deformation and rebound of this drop are obtained and solved numerically. Some typical results for heat transfer and drop dynamics are presented. Comparisons of predicted and experimental values are made, and it is shown that the model does approximately predict heat transfer and drop behavior. An experimental investigation of the effect of drop subcooling on heat transfer to an impinging water drop is also reported. Heat transfer data were taken for drops with 140 F and 70 F subcooling impinging on a surface heated to approximately 1200 F. Approach velocities ranged from 5.7 to 10.5 ft/sec and the drops were 418 to 490 microns in diameter. The data show a definite increase in heat transfer with drop subcooling. Dissert. Abstr

N70-42334*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF HEAT TRANSFER IN A BOUNDED TWO-DIMENSIONAL POROUS REGION AND APPLICATION TO A POROUS SQUARE DUCT

Marvin E. Goldstein and Robert Siegel Washington Oct. 1970 88 p refs
(NASA-TN-D-6065; E-5677) Avail: NTIS CSCL 20D

Two-dimensional transpiration heat conduction is considered for a porous region bounded by four surfaces. Two opposing

surfaces have no fluid flow or heat transfer across them. The other two surfaces are in contact with reservoirs at differing pressures so that fluid is forced to flow through the region. The flow exit side of the region can have an arbitrary temperature or heat flux distribution imposed along it. As a result of the boundary conditions the porous region occupies a rectangle in a suitable complex potential plane. The energy equation is transformed into the potential plane, and the general solution is found in this rectangular region. The solution can then be transformed into the geometry in the physical by conformal mapping. The method is illustrated by obtaining the heat transfer characteristics of a square duct with porous walls.
Author

N70-42365*# General Electric Co., Schenectady, N.Y. Mechanical Engineering Lab.
HEAT TRANSFER ON A FLAT PLATE IN HELIUM AT MACH NUMBERS 67.3 AND 87.6 AND IN HYPERSONIC CORNER FLOW WITH AIR AT MACH NUMBER OF 19
H. T. Nagamatsu, R. E. Sheer, Jr., and W. T. Pettit 7 Aug. 1970 47 p refs
(Contract NASw-1785)
(NASA-CR-114257) Avail: NTIS CSCL 20D

Local surface heat transfer rates were measured with helium at Mach numbers of 67.3 and 86.8. The strong interaction parameter varied from 730 to 16,500 and leading edge Knudsen numbers were 8.39 and 17.1 respectively. Towards the leading edge region the heating rates were much less than the theoretical prediction due to the rarefied flow effects but much greater than the diffuse free molecule limit. The rates in the corner flow region were determined with air at a Mach number of approximately 19. Tests were conducted at rarefied and continuum flow conditions with unit Reynolds numbers of approximately 900 and 29,000 with corresponding leading edge Knudsen numbers of 35 and 1.0. At low density conditions the local heating rates were increased approximately 35 percent in the vicinity of the corner region, but at continuum flow conditions the heat transfer rates were not increased as much as the rarefied hypersonic flow. By comparing the local heat transfer coefficient in the corner flow region with the strong interaction theory, it was possible to determine the corner flow effects on the heating rates.
Author

N70-42467# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Elektrische Antriebe und Energetik.
DIAGRAMS OF STATE FOR NITROGEN IN THERMODYNAMIC NON-EQUILIBRIUM [ZUSTANDSDIAGRAMME FUER STICKSTOFF IM THERMODYNAMISCHEN NICHTGLEICHGEWICHT]
Uwe Sprengel May 1970 28 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-23) Avail: NTIS; ZLDI Munich: 9.50 DM

Assuming elevated electron temperatures, the specific enthalpies and entropies for nitrogen in a pressure range from 0.01 to 100 torr and gas temperatures from 2,000 to 15,000 K are calculated and plotted in related diagrams. The ratios of the electron temperatures to the gas temperatures range between 1 and 2, but only single ionization is assumed.
Author (ESRO)

N70-42541# Rocket Propulsion Establishment, Westcott (England).
CONVECTIVE HEAT TRANSFER IN ROCKET ENGINES. PART 4: HEAT TRANSFER IN THE COMBUSTION CHAMBER
R. C. Parkinson Apr. 1969 41 p refs
(RPE-TR-69/5) Avail: NTIS

A boundary layer method previously developed for predicting the heat transfer to rocket nozzles was extended to the prediction of heat transfer rates inside rocket combustion chambers. The important factor is shown to be the available enthalpy of the partly burned gases in the free stream. A mixing theory is presented which enables the rate of increase of available enthalpy to be calculated. The theory was applied to 524 measurements, made over a range of propellent combinations and injector designs, and an overall rms deviation of approximately 15 per cent was obtained. The effects of injector patterns on circumferential heat transfer rates and of combustion instability are also considered.
Author (ESRO)

N70-42950# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering.
VAPOR COMPRESSIBILITY EFFECTS IN HEAT PIPES
Edward K. Levy and Shyan-Fu Chou May 1970 76 p refs
(Contract AT(30-1)-4095)
(NYO-4095-1; PR-1) Avail: NTIS

The preliminary results from an analytical study of the effect of vapor dissociation and vapor supersaturation on the sonic velocity limit in sodium heat pipes are presented. For a sodium vapor flow which is in chemical equilibrium but which is frozen with respect to liquid-vapor phase change, computed values for the maximum rate of heat transfer based on the sonic limit and for the axial drop in heat pipe temperature are presented and are shown to be in good agreement with recent experimental results from the literature. A comparison between the chemical equilibrium, reacting, and frozen flow analyses shows small variations in maximum heat transfer rates but large differences in the amounts of vapor supersaturation.
Author (NSA)

N70-42967# Sandia Corp., Albuquerque, N.Mex.
IMPROVEMENTS IN THE CHART D RADIATION HYDRODYNAMIC CODE 1: ANALYTIC EQUATIONS OF STATE
Samuel L. Thompson Jan. 1970 121 p refs
(SC-RR-70-28) Avail: NTIS

A set of equation-of-state subroutines for in-line hydrodynamic code use is described. The information generated is thermodynamically complete and self-consistent. Any combination of elements may be included. The range of validity is large; temperatures from 100 K to 10 to the 8th power K and nearly all important densities. Solids, liquids, vapors, plasmas, and phase mixtures are treated. Simple solid–solid phase transitions are included. An approximate value of the Rosseland mean opacity is calculated. The routines were written for the CHART D radiation diffusion hydrodynamics code but may easily be included in other codes. With minimal effort an equation of state of any substance can be generated.
Author (NSA)

N70-43048# Centre National de la Recherche Scientifique, Marseilles (France). Centre de Microcalorimetrie et de Thermochimie.
THERMOCHEMICAL STUDY OF SOME INORGANIC AND ORGANIC SALTS OF COBALT, NICKEL AND COPPER [ETUDE THERMOCHIMIQUE DE QUELQUES SELS MINERAUX ET ORGANIQUES DE COBALT, DE NICKEL ET DE CUIVRE]
My Le Van (Ph.D. Thesis–Aix-Marseille Univ.) Jun. 1970 144 p refs In FRENCH; ENGLISH summary Sponsored by CEA
(CEA-R-3954) Avail: NTIS

Differential enthalpy analyses were made on the halides, halide oxy-acid salts, nitrates and sulfates and the alkanoates and dicarboxylates of cobalt, nickel and copper using a Tian-Calvet high-temperature microcalorimeter. Thermocrystallography, thermogravimetry, spectroscopy and gas-phase chromatography were also used. Microcalorimeters were studied in detail and a satisfactory device was developed. It is shown that intermediate hydrates exist. Various enthalpies of transformation were evaluated and possible reaction mechenisms are discussed. The normal formation enthalpies of several series of alkanoates and dicarboxylates were measured and a graphical method was devised for evaluating the kinetic parameters of heterogeneous dissociations using the thermograms.
Author (ESRO)

N70-43111*# Battelle Memorial Inst., Columbus, Ohio.
STUDY ON JOINT THERMAL CONDUCTANCE IN VACUUM Final Report

J. F. Lagedrost, H. R. Miller, and F. A. Creswick 30 Sep. 1970 34 p refs
(Contract NAS8-25451)
(NASA-CR-102887) Avail: NTIS CSCL 20M

The feasibility of using bright leveling copper plating to improve the thermal conductance of mechanical joints in a vacuum was investigated. Large variations in thermal conductance were observed to result from re-positioning as-machined specimens in the experimental apparatus. A general improvement in joint conductance was observed from the application of the copper plating; however, a conclusive demonstration that the copper plating alone provides improvement was not obtained. The observed conductance values for the plated specimens were in all cases greater than the average of values for the as-machined specimens, but in some individual measurements, as-machined specimens showed a higher conductance than the specimens after plating. It is concluded that other surface variables are as important as material and surface finish in affecting joint conductance, and a leveling copper plating applied to an as-machined surface will not by itself assure low thermal resistance. Author

N70-43113# Cornell Univ., Ithaca, N.Y. Dept. of Theoretical and Applied Mechanics.
UNIQUENESS OF SOLUTION IN THREE-DIMENSIONAL MELTING AND SOLIDIFICATION PROBLEMS
Bruno A. Boley Mar. 1970 20 p refs
(Contract N00014-67-A-0077-0009)
(AD-710434; TR-1) Avail: NTIS CSCL 20/13

Conditions for uniqueness of solution are established for three-dimensional heat conduction problems with change of phase. Two cases are considered, one in which the newly formed phase remains stationary upon formation, the other in which it is instantaneously removed. Various special examples are discussed. Author (TAB)

N70-43120 National Lending Library for Science and Technology, Boston Spa (England).
THE PROBLEM OF THE IGNITION OF AN EXPLOSIVE MIXTURE BY A HOT METAL FILAMENT [PROBLEMY ZAPALENI VYBUSNE SMESI ZHAVYM KOVOVYM VLAKNEM]
Z. Ohnut 11 May 1970 33 p refs Transl. into ENGLISH from Vedeckovyskumny Uhelny Ustav Zprava (Czechoslovakia), no. 61, 1968 p 1–36
(NLL-SMRE-Trans-5693-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

Potential ignition of an explosive gas mixture in an intrinsically safe installation is investigated. Particular attention is given to the breaking of electric bulbs, thermal effects of the electric current, coal dust explosions, and sparks from hot filaments. Conclusions show ignition depends on the material of the hot filament, electrical parameters, and design of the installation. Conclusions also indicate the explosive factors may be controlled by the mechanical design and adjustments of the electrical parameters. E.H.W.

N70-43125*# Louisiana State Univ., Baton Rouge. Div. of Engineering Research.
RESEARCH FACILITIES FOR THE MEASUREMENT OF THE MA-3 ATLAS VERNIER ENGINE PLUME PROPERTIES
Richard C. Farmer and Simon Hacker 15 Aug. 1970 71 p refs
(Grant NGL-19-001-024)
(NASA-CR-110900) Avail: NTIS CSCL 21B

The combustion laboratory facilities include engine, probe, control panels, gas analysis, and a data acquisition system. The MA-3 Atlas vernier engine used was fired five times and in the last three experiments all hardware available was used. All systems performed flawlessly with the exception of the probe. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N70-41884*# Translation Consultants, Ltd., Arlington, Va.
OPERATIONAL AIR TRAFFIC CONTROL CONSIDERING SEVERAL OPTIMALITY CRITERIA [OPERATIVNOYE UPRAVLENIYE VOZDUSHNYM DVIZHENIYEM S UCHETOM NESKOLKIKH KRITERIYEV OPTIMALNOSTI]
A. I. Volevach et al Washington NASA Oct. 1970 11 p refs Transl. into ENGLISH from the publ. 'Slozhnye Sistemy Upravleniya' Kiev, Naukova Dumka Press, 1969 p 36–43
(Contract NASw-2038)
(NASA-TT-F-13276) Avail: NTIS CSCL 01E

Development of a two level system of air traffic control which avoids conflicts between aircraft on the runway and in flight and which minimizes deviations from the prescribed landing times is described. The problem of avoiding conflict between aircraft during flight is reduced to making a complex decision with allowance for several optimality criteria and for a limited number of control inputs. An algorithm for selecting the control parameter on the basis of compromises is proposed. Author

N70-41890*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
ON THE DETERMINATION OF UNIVERSAL TIME AND THE USE OF US NAVAL OBSERVATORY TIME SERVICE BULLETINS, NOTICES AND ANNOUNCEMENTS
W. E. Fizell May 1970 32 p refs
(NASA-TM-X-65346; X-521-70-188) Avail: NTIS CSCL 17B

General information is presented on time and time determination. The extensive collection of data in time corrections, time variations, coordinated universal time (UT) off-sets, etc., covering the years from 1956 to 1970 is given. Author

N70-41893# National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.
ANNOTATED ACCESSION LIST OF DATA COMPILATIONS OF THE OFFICE OF STANDARD REFERENCE DATA
Herman M. Weisman and Gertrude B. Sherwood Sep. 1970 196 p refs
(NBS-TN-554) Avail: SOD $1.50

The National Bureau of Standards, Office of Standard Reference Data has attempted to acquire all significant reference data compilations on a worldwide basis. This publication lists the collection of documents so acquired, together with their abstracts. The documents are organized in the following categories: General Collections, Nuclear Properties (including Fundamental Particle Properties), Atomic and Molecular Properties, Solid State Properties, Chemical Kinetics, Colloid and Surface Properties, Mechanical Properties, and Thermodynamic and Transport Properties. Sources of availability for the listed publications are also provided. Author

N70-42042# National Bureau of Standards, Washington, D.C.
AN AUTHOR AND PERMUTED TITLE INDEX TO SELECTED STATISTICAL JOURNALS
Brian L. Joiner, N. F. Laubscher (Natl. Res. Inst. for Math. Sci.), Eleanor S. Brown (Council for Sci. and Ind. Res.), and Bert Levy (HDL) Sep. 1970 511 p refs
(NBS-SP-321) Avail: SOD $5.75

Over 5,000 articles appearing in the indicated issues of the following journals are indexed: Annals of Mathematical Statistics

(1961–1969), Biometrics (1965–1969 No. 3), Biometrika (1951–1969), Journal of the American Statistical Association (1956–1969), Journal of the Royal Statistical Society, Series B (1954–1969 No. 2), South African Statistical Journal (1967–1969 No. 2), Technometrics (1959–1969). The articles indexed correspond to those appearing since the most recent cumulative subject index was published for the first six named journals, while for Technometrics all articles have been included even though a subject index exists for the first seven volumes. The index consists of three sections, an author index, a permuted title index and a bibliographic listing. In the permuted title index each article is listed under every important word appearing in its title. This index should consequently serve many of the functions of a conventional subject index. The author index is similar to a conventional author index. Author

N70-42150# Naval Missile Center, Point Mugu, Calif. Target Dept.

MANAGEMENT PREPARES FOR COLLECTIVE BARGAINING AT THE NAVAL MISSILE CENTER

T. C. Lockhart 20 Jul. 1970 128 p refs

(AD-709417; NMC-TP-70-46) Avail: NTIS CSCL 5/9

The purpose of the report is to describe the problems facing the Naval Missile Center in dealing with labor unions. Although the Navy has historically been one of the key departments of the Federal government involved in labor relations, until recently little, if any, effect of employee organizations or employee unions had been experienced by the management of the Naval Missile Center. Author (TAB)

N70-42295*# Pittsburgh Univ., Pa. Knowledge Availability Systems Center.

THE SPACE AND TECHNOLOGY TRANSFER PROGRAM Quarterly Report, Jun. – Aug. 1970

Edmond Howie Aug. 1970 88 p

(Grant NSR-39-011-106)

(NASA-CR-110768) Avail: NTIS CSCL 05B

Operational activities of the space and technology transfer program are presented for the KASC regional dissemination center at the University of Pittsburgh. The activities reported include the following three areas of operations: (1) Marketing operations are described and include income breakdown, client breakdowns, tools of marketing, administrative support, and new projects. (2) Technical operations are detailed by statistical data, charts, and supporting narrative related to search services, document services, and abstract packet services. (3) Analysis operations are reported by activity descriptions related to the file content and include strategy preparation, manual searching, review of search output, and technology utilization. D.L.G.

N70-42298*# Syracuse Univ., N.Y.

MULTIDISCIPLINARY STUDIES IN MANAGEMENT AND DEVELOPMENT PROGRAMS IN THE PUBLIC SECTOR Semiannual Report, 1 Jan. – 30 Jun. 1970

Martin E. Barzelay Sep. 1970 33 p

(Grant NGL-33-022-090)

(NASA-CR-110771; SAR-5) Avail: NTIS CSCL 05A

Major project research is reported with reference to the role of the project manager, NASA/business relations, case studies of science-technology national decision making, regulations in space, social and physical processes in systems science, and non-economic criteria for evaluating space application projects. Additional studies concern exposition and real time decision making, partitioning NASA incentive contracts, multidisciplinary research in universities, education and research as related to public administration, and the accuracy of cost estimation for Apollo decision making. P.A.B.

N70-42314# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

RESEARCH Semiannual Summary Report No. 12, Dec. 1969 – May 1970

May 1970 151 p refs

(Contract N00014-67-A-0226-0004)

(AD-709977) Avail: NTIS CSCL 9/3

Contents: Bioengineering; Automatic controls; Energy sources and systems; Electromagnetic fields; Communication sciences; Nonlinear circuits and systems; Computers and automata; Materials and electronic devices; Laboratory for applications of remote sensing (LARS). TAB

N70-42557# Battelle Inst., Frankfurt am Main (West Germany).

BATTELLE INFORMATION NUMBER 5

Aug. 1969 56 p refs

Avail: NTIS

CONTENTS:

1. ON THE BIOLOGICAL DISPOSAL OF MUNICIPAL REFUSE F. Fink and W. Schoenborn p 4–9 refs (See N70-42558 24-34)

2. REFUSE INCINERATION TODAY AND TOMORROW Ferdinand Fink and Hans-Peter Steinbach p 10–17 refs

3. FORMATION OF IRON(II) CHLORIDE AND IRON(III) CHLORIDE AT HIGH TEMPERATURE CORROSION IN FURNACES R. Rasch p 18–22 refs (See N70-42559 24-17)

4. ANALYSIS OF COLLOIDAL AIR AND WATER POLLUTION BY LIGHT SCATTERING J. Bol, J. Gebhart, C. Roth, and G. Wurzbacher p 23–29 refs (See N70-42560 24-05)

5. BIOLOGICAL WASTE DISPOSAL AND ITS LIMITS W. Schoenborn p 30–35 (See N70-42561 24-04)

6. [THIN FILM SOLAR CELLS] R. Ziegler (Ges. fuer Weltraumforsch.), W. Ruppel (Karlsruhe Univ.), G. Guettler (Frankfurt Univ.), H. J. Queisser (Frankfurt Univ.), K. K. Reinhartz (ESTEC) et al p 48–54 (See N70-42562 24-03)

N70-42558# Battelle Inst., Frankfurt am Main (West Germany).

ON THE BIOLOGICAL DISPOSAL OF MUNICIPAL REFUSE

Ferdinand Fink and Wolfgang Schoenborn *In its* Battelle Inform. No. 5 Aug. 1969 p 4–9 refs (See N70-42557 24-34)

Avail: NTIS

In the anaerobic digester of sewage plants the refuse sludge is mixed with the sewage sludge as a final step in waste disposal, and nearly all of it is rapidly converted into sterile digested sludge and gas. The digested sludge, which is free from pathogenic organisms, can be used in horticulture and agriculture. ESRO

N70-42647# University of Southern Calif., Los Angeles. Electronic Sciences Lab.

SOLID STATE, PLASMAS AND APPLIED ELECTROMAGNETICS, INFORMATION SCIENCES, AND BIOMEDICAL ENGINEERING AND MATHEMATICS Consolidated Semiannual Progress Report, 1 Oct. 1969 – 31 Mar. 1970

Mar. 1970 217 p refs

(Grant AF-AFOSR-1622-69)

(AD-710212; AFOSR-70-2153TR) Avail: NTIS CSCL 20/12

Summaries are given of research activities in the following fields: Semiconductors; Quantum electronics and lasers; Magnetism; Defects in crystals; Metals; Plasmas; Millimeter wave radiometry; Control systems; Communication and radar systems; Switching, automata theory, and computers; Biomedical engineering; and Biomedical mathematics. TAB

N70-42648# Office of Research Analyses, Holloman AFB, N.Mex.
SOME TECHNOLOGICAL TRENDS OF IMPORTANCE TO THE AIR FORCE Final Report
Joseph P. Martino Jun. 1970 33 p
(AD-709869; ORA-70-0008) Avail: NTIS CSCL 5/1

The report presents the results of fitting appropriate trend curves to several sets of data on technologies of interest to the Air Force. These trends, when projected, represent technological forecasts. The likelihood of continuation or change of the trend is discussed in each case, with implication for R and D planning. TAB

N70-42660# Battelle Inst., Frankfurt am Main (West Germany).
BATTELLE INFORMATION NUMBER 4
Apr. 1969 42 p refs
Avail: NTIS

CONTENTS:

1. HETEROJUNCTION DIODES AS A BASIS FOR THE DEVELOPMENT OF NEW SEMICONDUCTOR DEVICES D. Bonnet and H. Rabenhorst p 5–10 refs (See N70-42661 24-09)
2. LONG-TERM TRENDS IN LEISURE-TIME ACTIVITIES AND THEIR EFFECTS ON THE SPORTS-GOODS SECTOR: CONSIDERATIONS ON METHODS FOR SOLVING FUTURE PROBLEMS Gertrud Collin and Horst Philipps p 11–17 refs
3. CELL BIOLOGY RESEARCH GROUP AT BATTELLE p 22–23 (See N70-42662 24-04)

N70-42691# Battelle Inst., Frankfurt am Main (West Germany).
BATTELLE INFORMATION NO. 2
Sep. 1968 60 p refs
Avail: NTIS

CONTENTS:

1. METALLURGICAL FACTORS GOVERNING THE DEVELOPMENT OF HIGH-TEMPERATURE MATERIALS P. Esslinger and H. Winter p 4–18 refs (See N70-42692 24-17)
2. REPORTS FROM THE DEPARTMENTS p 19–34
3. GROUP PROJECTS p 35–36
4. [HEAT-RESISTANT PLASTICS] B. Vollmert (Tech. Univ. Karlsruhe), F. Grundschober, W. Gruensteidl (N.V. Philips, Eindhoven), and M. Sander p 37–42 (See N70-42693 24-18)

N70-42711*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A BY-PRODUCT OF NASA: TRANSFER OF NEW TECHNOLOGY TO VARIOUS SECTORS OF THE ECONOMY
Charles Henry Whitlock, III (M.A. Thesis – Coll. of William and Mary) Apr. 1970 110 p refs
(NASA-TM-X-66393) Avail: NTIS CSCL 05B

The various processes of technology transfer currently being utilized by NASA are considered to extract knowledge concerning the technology transfer process and to describe areas where additional effort is required. Methods of technology transfer for both formal technical publications and other informal publications are examined. Services available to both the aerospace industry and the civilian economy are reviewed. Shop- or production-oriented innovations as well as new scientific technology are considered. Patent opportunities in terms of licenses and waivers available to the civilian economy are also examined. Results indicate that the system of publications, computerized storage and search services, and other processes for transferring technology to both the aerospace industry and civilian industry are highly successful in spite of its complexity and relative newness. NASA patent and licensing policy appears flexible and well geared for effective technology transfer. Author

N70-42845*# Louisiana State Univ., Baton Rouge. Engineering Research Div.
A CONCEPTUAL FRAMEWORK FOR TRANSPORTATION RESEARCH AT MISSISSIPPI TEST FACILITY OF NASA
Ara Arman and Aman J. Claudet, Jr. 1970 130 p refs
(Grant NGL-19-001-024)
(NASA-CR-110893) Avail: NTIS CSCL 05A

A model of the transportation system was constructed in which various components of the system can be separated and studied individually and then assembled into the total system for application. An initial model of the ground transportation system was developed to determine the various components of the system, the problems associated with each component, and the relationship of the problems to the other components of the system. The development of the system, the model and its use, and a description of the facilities are presented and discussed. Author

N70-42966# Office of Research Analyses, Holloman AFB, N.Mex.
LOG-NORMAL DISTRIBUTION ANALYSIS OF THE AEROSPACE RESEARCH PROJECTS
Eugene Kosik Apr. 1970 35 p refs
(AD-709867; ORA-70-0004) Avail: NTIS CSCL 5/1

The purpose of the study is to determine whether OAR research projects follow the log-normal distribution pattern found by B. V. Dean for the U. S. Army and Navy research project costs. The log-normal probability distribution would provide a model to measure research management performance which could be used to evaluate management efficiency and aid in improving the research planning and budgeting process. A simple factor analysis with orthogonal rotations performed on five of OARs work unit parameters - fiscal year dollars, man years, total dollars, total duration and annual rate - indicated that fiscal year dollars was a highly significant factor. Therefore, 1968 and 1969 costs for 18 ORA, 48 ARL and 289 AFCRL work units were analyzed and compared to log-normal probability distributions with the same means and standard deviations as the data. The goodness of fit in each case was checked by plotting the data on log-normal probability paper and also by comparison with appropriate chi-square statistics. The goodness of fit is discussed and recommendations for further study of the data are made. Author (TAB)

N70-43072*# National Aeronautics and Space Administration, Washington, D. C.
INTERNATIONAL PROGRAMS
Sep. 1970 19 p
(NASA-TM-X-66398) Avail: NTIS

The international space activities of NASA are reported for the period of 1958 to 1970. The cooperative probe projects, and the experiments on NASA satellites are listed. The international programs are described for space sciences, space applications, and space operations support. F.O.S.

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EUROPEAN

An extensive collection of NASA and NASA-sponsored publications is maintained by the National Lending Library for Science and Technology, Boston Spa, Yorkshire, England. By virtue of arrangements other than with NASA, the National Lending Library also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols "#" and "*", from: ESRO/ELDO Space Documentation Service, European Space Research Organization, 114, av de Neuilly, 92-Neuilly-sur-Seine, France.

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NEW NASA PUBLICATIONS

Remote Sensing of Earth Resources: A Literature Survey with Indexes (NASA SP–7036)

A special bibliography containing almost 3700 citations to unclassified report and journal literature references on the remote sensing of the Earth's resources, covering items processed into the NASA technical information system during the period January 1962–February 1970. The subject matter encompasses resources both natural and cultural: specifically, agriculture and forestry; geography and cartography; urban and related development; hydrology and water resources; oceanography and marine resources; and the research and development of instrumentation for the remote sensing of these resources. The bibliography is divided into nine special subject categories. Subject, personal author, corporate source, contract number, and report number indexes are included. All items were announced originally in *Scientific and Technical Aerospace Reports* (STAR) or *International Aerospace Abstracts* (IAA). *Paperbound.* 1232 pp. Available from the National Technical Information Service, Springfield, Va. 22151, for $10.00.

Effects of Structural Flexibility on Launch Vehicle Control Systems (NASA SP–8036)

A NASA space vehicle design criteria publication in the guidance and control series. This monograph deals with the problems related to the interaction of the entire space vehicle system, including payloads and propellants. Since control forces can feed energy into the structure of the space vehicle at various frequencies, the ensuing structural deflections may lead to serious problems. The document provides guidelines for the design of the control system which, if followed, will insure a net flow of energy out of the system, thereby avoiding excessive deflections. *Paperbound.* 56 pp. Available from the National Technical Information Service, Springfield, Va. 22151, for $3.00.

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